HORIZONTAL DIRECTIONAL DRILL ANALYSIS
WHITE HOUSE LANE CROSSING
PADEP SECTION 105 PERMIT NO.: E22-617
PA-DA-0005.0000-RD-16
(SPLP HDD No. S3-0011-16)

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This reanalysis of the horizontal directional drill (HDD) installation of a 16-inch diameter pipeline that traverses White House Lane in Lower Swatara Township, Dauphin County, Pennsylvania, is in accordance with Condition No. 3 of the Stipulated Order issued under Environmental Hearing Board Docket No. 2017-009-L. Condition No. 3 stipulates, for HDDs initiated after the temporary injunction issued by the Pennsylvania Department of Environmental Protection (PADEP) Environmental Hearing Board on July 25, 2017, a reanalysis must be performed on HDDs for which an inadvertent return (IR) occurs during the installation of one pipe (20-inch or 16-inch diameter) where a second pipe will thereafter be installed in the same right-of-way (ROW).

The installation of the 20-inch diameter pipeline using HDD was initiated before the temporary injunction issued by the Pennsylvania Department of Environmental Protection (PADEP) Environmental Hearing Board on July 25, 2017. This first pipeline HDD had two (2) inadvertent returns (IR), and therefore, the installation of the second pipeline (16-inch diameter) requires reanalysis. The IRs for the 20-inch pipeline was remediated and the HDD installation for the 20-inch diameter pipeline was completed.

The 16-inch pipeline HDD is referred to herein as HDD S3-0011-16.

PIPE INFORMATION

16-Inch: 0.438 wall thickness; X-70.

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

PERMITTED HORIZONTAL DIRECTIONAL DRILL DESIGN SUMMARY: 16-INCH

- Horizontal length: 1,800 feet (ft)
- Entry/Exit angle: 14 degrees
- Maximum Depth of cover: 33 ft
- Pipe design radius: 1,600 ft

ROOT CAUSE ANALYSIS FOR THE 20-INCH PIPELINE INSTALLATION INADVERDENT RETURNS

The occurrence of the IRs during the installation of the 20-inch diameter pipeline resulted from the shallow depth of cover at the HDD exit site while proceeding through unconsolidated material and groundwater in the upper 30 ft of the profile.

GEOLOGY

According to the Pennsylvania Department of Conservation and Natural Resources (PA DCNR, 2000), the S3-0011-16 HDD site is situated in the Gettysburg-Newark Lowland Section of the Piedmont Physiographic Province. The predominant rock types consist mainly of red shale, siltstone, and sandstone with some conglomerate and diabase. The predominant geologic structure within this physiographic section consists of a half-graben having low, monoclinal, northwest-dipping beds. The surface drainage pattern is both dendritic and trellis.

According to Google Earth, the proposed HDD profile is exclusively underlain by the Triassic age Gettysburg Formation (Trg). The Gettysburg Formation is composed of reddish-brown to maroon, silty

mudstone and shale containing thin red sandstone interbeds with several thin beds of impure limestone. The overlying soil mantle is generally thin. The ease of excavation (and drilling) is classified as moderately easy. Drilling rates are typically moderate to fast except in areas where the rock is adjacent to diabase intrusions making the rock harder with a slower drilling rate (Geyer and Wilshusen, 1982). The general structure of the Newark Group is a north-northwestward dipping homocline.

Karst geology is not present at this HDD location. SPLP possesses a full geologic profile from the drilling of the 20-inch pipeline. No additional information is needed to evaluate the 16-inch HDD.

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

HYDROGEOLOGY, GROUND WATER, AND WELL PRODUCTION ZONES

According to Wood (1980) and Low, et al. (2002), groundwater within the elastic rocks of the Gettysburg Formation within Dauphin County occurs under both unconfined (i.e., water table) and confined conditions. The direction of groundwater flow within the elastic rocks of the Gettysburg Formation in Dauphin County is largely controlled by the hydraulic gradient and spatial variability of hydraulic conductivity. The groundwater flow system in the elastic rocks is highly anisotropic with the predominant flow direction parallel to the strike of the rock beds. The potential for well interference related to pumping is generally greatest for wells aligned parallel to the strike, rather than in wells drilled in the direction of bedding dip (i.e., perpendicular to the strike). The presence of diabase often acts as a barrier to flow (Becher and Root, 1981; and Wood, 1980).

Based on the initial Tetra Tech geotechnical report, groundwater was encountered at 18 feet bgs in Soil Boring (SB) SB-01, 22 feet bgs in SB-02, and 12.5 feet bgs in SB-03. In the recent geotechnical report prepared by Intertek Professional Service Industries Inc., at Boring B-01, located near the northern HDD exit point overlying sandstone bedrock of the Gettysburg Formation, groundwater was encountered at 91 feet bgs. At Boring B-02 drilled in the Gettysburg Formation near the southern HDD entry point, groundwater was encountered in the overburden at 15 feet bgs.

Well records from the PA DCNR Pennsylvania Groundwater Information System (PaGWIS) database were reviewed to identify domestic water supply and other wells located within a ½-mile radius of the proposed HDD (PaGWIS, 2019). The search identified 25 wells within the ½-mile radius of the HDD. Of these 25 wells, one is listed as destroyed (PAWell ID 17574); and four wells are listed as abandoned (PA Well IDs 636500, 636499, 637132, 622632). The remaining wells consist of 11 domestic supply wells; three wells identified as industrial; nine wells identified as unused, which include the destroyed and abandoned wells listed above, along with four wells listed as observation wells; and one well identified as commercial. A map showing the well locations relative to the proposed HDD location is included in the attached Hydrogeology Report. Based on the PaGWIS database recorded static water level measurements range from 10 to 55 feet bgs. Reported well yields range from O to 450 gallons per minute (gpm). Based on the PaGWIS database, seven of the wells identified above were reported as being completed in the Gettysburg Formation; however, one well was identified as being in the Martinsburg Formation, which is assumed to be incorrect.

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

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INADVERTENT RETURN (IR) DISCUSSION

Inadvertent returns (IRs) of drilling fluids occurred during the pilot and reaming phases at approximately 210 feet south of the exit point, and on the east side of White House Lane approximately 173 feet south of the exit point.

The profile for the 16-inch pipeline has been redesigned so that it is deeper than the installed 20-inch pipeline, and the entry and exit angles increased to allow a rapid descent into and exit out bedrock. These adjustments in combination with the implementation of drilling best management practices will be used to minimize the potential for IRs during drilling of the 16-inch pipeline.

ADJACENT FEATURES ANALYSIS

This HDD location is located approximately 7.8 miles southeast of the City of Harrisburg in Dauphin County, Pennsylvania. The pipeline alignment crosses under White House Lane, Harrisburg Pike, Rhoda Alley, and Eshelman Street.

The pipeline route runs parallel to White House Lane and two existing SPLP pipelines; and perpendicular to State Route 230 (West Harrisburg Pike) between Martin Avenue and Lloyd Lane. At this HDD location, private residences, commercial buildings, sidewalks, various utilities (e.g., overhead and underground electric lines, storm water lines, sewage lines, water lines, and gas lines), and Lisa Lake (Pond B9) are immediately adjacent to the existing permanent utility easement, as well as parallel to and crossing perpendicular to the easement. The presence of these structures and the aquatic resource necessitated the HDD to avoid effects to public infrastructure, utilities, residences, commercial uses and aquatic resources. Additionally, this HDD avoids surficial impacts to wetlands B65 and W118, a palustrine forested (PFO) and palustrine emergent (PEM) wetland, respectively.

To identify water well locations relative to the revised (extended) 16-inch HDD profile, in February 2018 SPLP sent certified letters to all landowners with properties within 450 ft of the revised HDD alignment. Public Water Suppliers within 0.5 mile were also identified and notified of the project. As a result of these communications, three water wells were identified within the 450-foot buffer of the alignment. An illustration on the location of these water wells is provided in the Hydrogeologic Report in Attachment 1. No additional information on depth to water, well yield or pump setting was reported for these wells.

To further avoid and mitigate any adverse effects from the HDD to private water wells, and in accordance with the requirements of the Stipulated Order, SPLP will transmit a copy of this HDD analysis to all landowners having a property line within 450 ft of any direction of this HDD location.

ALTERNATIVES ANALYSIS

As required by the Order, the reanalysis of HDD S3-0011-16 includes an evaluation of open cut alternatives and a re-route analysis. As part of the PADEP Chapter 105 permit process for the Mariner II East Project, SPLP developed and submitted for review a project-wide Alternatives Analysis. During the development and siting of the Project, SPLP considered several different routings, locations, and designs to determine whether there was a practicable alternative to the proposed impact. SPLP performed this determination through a sequential review of routes and design techniques, which concluded with an alternative that has the least environmental impacts, taking into consideration cost, existing technology, and logistics. The baseline route provided for the pipeline construction was to cross every wetland and stream on the project by open cut construction procedures. The Alternatives Analysis submitted to PADEP conceptually analyzed the potential feasibility of any alternative to baseline route trenched resource crossings (e.g., reroute, conventional bore, HDD). The decision-making processes for selection

of the HDD instead of an open cut crossing methodology is discussed thoroughly in the submitted alternatives analysis and was an important part of the overall PADEP approval of HDD plans as currently permitted. As described below, the open cut and re-route analyses have confirmed the conclusions reached in the previously submitted Alternatives Analysis.

Open-cut Analysis

Sunoco Pipeline, L.P. (SPLP) specifications require a minimum of 48-inches of cover over the installed pipelines. The Pennsylvania Department of Transportation (PennDOT) cover requirements under public roadways is 60-inches of cover.

Considering the number and location of adjacent features and utilities, an excavation of sufficient size to accommodate an open trench construction method could result in disturbances to residences and damages and disruption of service on existing utility lines; therefore the open trench alternative is not preferred. The assessed area of impact by this open cut plan would directly affect 0.05 acre of wetlands, including approximately 0.001 acre of forested wetland conversion.

Conventional auger bore is technically limited to less than 200 linear foot at a time varying by the underlying substrate. Due to the spacing constraints at the location of these HDDs, there are no subset locations within this length of area to feasibly employ this type of installation method.

Re-Route Analysis

The pipeline route as currently permitted follows an existing SPLP easement. This alignment bypasses or avoids directly White House Lane, Harrisburg Pike, Rhoda Alley, and Eshelman.

No practicable re-route option lies to the east or west of the proposed route that would not transect the same infrastructure transected by the proposed route. A shift to the east would result in new “greenfield” impacts to forested woodlands and forested and scrub/shrub wetlands. A shift to the west would result in new “greenfield” impacts to forested woodlands, forested wetlands, and Lisa Lake. Any reroute considered would be a new utility corridor requiring consent of newly-affected landowners or the use of eminent domain/condemnation and would create a new land encumbrance on every private property crossed.

This re-route analysis conducted for the White House Lane HDD confirms the conclusions reached in the previously submitted alternatives analysis.

REVISED HORIZONTAL DIRECTIONAL DRILL DESIGN SUMMARY: 16-INCH

Additional geologic investigations have been completed, and the “as built” record for the 20-inch pipeline has been utilized in the redesign of the planned 16-inch HDD. The redesign adjusts the HDD profile deeper to minimize the risk of drilling fluid loss, drilling difficulties, and IRs. A summary of the redesign factors is provided below. The original and redesigned 16-inch HDD plan and profile drawings are provided in Attachment 2.

- Horizontal length: 1,800 ft
- Entry/Exit angle: 16 degrees
- Maximum Depth of cover: 96 ft
- Pipe design radius: 2,000 ft

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CONCLUSION

As shown on Figure 2 in Attachment 2, the redesigned HDD profile for the 16-inch pipeline is deeper, with a maximum depth of cover increased by approximately 63 ft from the permitted design and the entry and exit angles increased to rapidly proceed into and exit out of the bedrock. These adjustments reduce the risk of IRs.

The redesign of the HDD will not prevent all IRs. IR's are common on entry and exit of the drilling tool and other measures are required to minimize IR potential. In particular, upon the start of this HDD, Sunoco will employ the following HDD best management practices:

- SPLP will provide the drilling crew and company inspectors the location(s) data on potential zones of higher risk for fluid loss and IRs, including the area related to previous IRs, and potential zones of fracture concentration identified by the fracture trace analysis, so that monitoring can be enhanced when drilling through these locations.

- SPLP will require and enforce the use of annular pressure monitoring during the drilling of the pilot holes, which assists in immediate identification of pressure changes indicative of loss of return flows or over pressurization of the annulus to manage development of pressures that can induce an IR;

- SPLP inspectors will ensure that an appropriate diameter pilot tool, relative to the diameter of the drilling pipe, is used to ensure adequate "annulus spacing" around the drilling pipe exits to allow good return flows during the pilot drilling;

- SPLP will implement short-tripping of the reaming tools as return flow monitoring indicates 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 all drilling phases, the use of Loss Control Materials (LCMs) can be considered if indications of a potential IR are noted or an IR is observed. However, the use of LCMs are less effective below 70 ft of the ground surface. The AP below that depth can exceed the effective stabilization capability of LCMs. This HDD is marginally below 70 ft of depth for the horizontal length of the profile. Accordingly, the corrective action needed to address the occurrence of Losses of Circulation or presence of fractures at greater depths below ground requires grouting of the HDD annulus. Two types of grouting will be utilized for corrective actions to seal the annulus. These are: 1) grouting using "neat cement"; and 2) grouting using a sand/cement mix. Neat cement grout is a slurry of Portland cement and water. The sand/cement grout mix is a slurry of mostly sand with a small percentage of Portland cement and activators that after setup results in a material having the competency of a friable sandstone or mortar. Both grouting actions require tripping out the drilling tool, and then tripping in with an open-ended drill stem to apply or inject the grout mixes.

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FEASIBILITY DETERMINATION

Based on the information reviewed by the Geotechncial Evaluation Leader, Professional Geologists, Professional Engineers, and HDD specialists, the HDD Reevaluation Team's opinion is that the proposed HDD design and implementation of the management measures contained within this re-revaluation report will minimize the risk of IRs and impacts to public and private water supplies during the construction phases of the HDD.

Pertaining to Horizontal Directional Drilling Practices and Procedures; Conventional Construction; Alternatives; and Environmental Effects

2-18-2019
Date

Larry J. Gremminger, CWB
Geotechnical Evaluation Leader
Mariner East 2 Pipeline Project

Pertaining to the practice of geology

2-18-19
Date

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COMMONWEALTH OF PENNSYLVANIA
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Pertaining to the pipeline stress and HDD geometry

2/16/19
Date

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WHITE HOUSE LANE CROSSING
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ATTACHMENT 1

GEOLOGY AND HYDROGEOLOGICAL EVALUATION REPORT

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February 18, 2019

Mr. Matthew Gordon
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Re: Sunoco PA Pipeline Project Mariner East II, White House Lane Horizontal Directional Drill (HDD) S3-0011, PA-DA-0005.0000-RD-16
Hydrogeological Re-Evaluation Report for 16-Inch Pipeline
Lower Swatara Township, Dauphin County, Pennsylvania
Rettew Project No. 096302011

EXECUTIVE SUMMARY

1. During drilling of HDD S3-0011 for installation of the 20-inch diameter pipeline, two inadvertent returns (IRs) of drilling fluids were identified during the pilot and reaming phases commencing at the western side of White House Lane approximately 210 feet south of the exit point, and on the east side of White House Lane approximately 173 feet south of the exit point.

2. The White House Lane HDD bore path is underlain by sedimentary rocks of the Triassic age Gettysburg Formation (Trg).

3. Geologic mapping and published reports indicate a moderate degree of bedrock fracturing in the Gettysburg Formation characterized by a blocky, moderately to well-developed pattern of open joints with low angle northwest dipping beds.

4. Water-bearing zones generally occur in secondary openings along bedding planes, joints, faults, and fractures. Water-bearing zones in the Gettysburg Formation are reported to be distributed within the first 5 to 900 feet of the subsurface, with the greatest density of water-bearing zones occurring within the upper 288 feet of the subsurface (half occur below 115 feet and 90% occur at depths of less than 288 feet).

5. To date, HDD operations have been completed at the S3-0011 location for the 20-inch pipeline. The 20-inch product pipe pull was completed on December 20, 2017.

6. Based on the hydro-structural characteristics of the underlying geology and the profile of the permitted 16-inch HDD within shallow unconsolidated soil materials and generally shallow bedrock, the proposed 16-inch HDD is susceptible to the inadvertent return (IR) of drilling fluids during HDD operations. A redesigned 16-inch HDD profile (**Attachment 2, Figure 2**) and Best Management Practices (BMPs) during drilling operations will be used to reduce the risk of an IR.

1.0 INTRODUCTION

The purpose of this report is to describe the hydrogeologic setting of the White House Lane (S3-0011) HDD location on the Sunoco Pipeline, L.P. (SPLP) Pennsylvania Pipeline Project – Mariner East II (PPP-ME2) Project. The White House Lane HDD (the site) is located in Lower Swatara Township, Dauphin County, Pennsylvania. The site forms the border between the Borough of Highspire to the northwest and Lower Swatara Township which lies on the southeast side of White House Lane. The HDD was designed to be drilled under State Route (S.R.) 230 and various underground utilities in a northeasterly direction parallel to White House Lane (refer to **Figure 1**). Due to the occurrence of three IRs during HDD operations for the 20-inch pipeline, this hydrogeologic report was prepared to address the potential for IRs during the proposed 16-inch drilling operations.

Local relief at the site is low to moderate and ranges in the vicinity of the site from approximately 311 feet above mean sea level (AMSL) to 325 feet AMSL (Google Earth, 2017). The area surrounding the HDD profile consists of urban commercial properties, suburban residential properties, and undeveloped parcels, some of which are open and some of which are forested. A portion of the HDD runs between White House Lane and Lisa Lake which is part of a commercial property operated as a mobile home park. The proposed 16-inch HDD entry point is at a surface elevation of 311 feet AMSL and forms a slightly concave HDD profile that slopes gently upward toward the northeast to an elevation of 325 feet AMSL at the HDD exit point. According to the redesigned 16-inch HDD drilling path profile provided by Sunoco, the proposed 16-inch HDD is deeper than the as-built 20-inch HDD and crosses under S.R. 0230, other neighborhood streets, and several adjacent buried utiliites at depths ranging from approximately 21 feet bgs (vs. 14 feet for the 20-inch) to 96 feet bgs (vs. 58 feet for the 20-inch). The proposed 16-inch HDD is located approximately between STATIONS 11256+00 and 11278+00 on the pipeline, for an overall horizontal length of 1,800 feet and a pipe length/bore path length of 1,824 feet. The existing 20-inch and proposed 16-inch S3-0011 HDD locations are shown on **Figure 1 and the redesigned 16-inch profile is included as Attachment 1**.

2.0 GEOLOGY AND SOILS

Thirteen (13) available published and online references were reviewed to evaluate the hydrogeology and soils present in the vicinity of the site. Detailed descriptions of the soils and bedrock geology underlying HDD S3-0011 are included below.

According to mapping performed by the Pennsylvania Department of Conservation and Natural Resources (PA DCNR, 2000), the S3-0011 HDD site is situated in the Gettysburg-Newark Lowland Section of the Piedmont Physiographic Province. The dominant topography is characterized by rolling lowlands, shallow valleys, and isolated hills with low to moderate relief. The predominant rock types consist mainly of red shale, siltstone, and sandstone with some conglomerate and diabase. The predominant geologic structure within this physiographic section

consists of a half-graben having low, monoclinal, northwest-dipping beds. The surface drainage pattern is both dendritic and trellis.

According to Google Earth, the proposed HDD trace is exclusively underlain by the Triassic age Gettysburg Formation (Trg). The bedrock geology at the site is illustrated on the geologic mapping included as **Figure 2**. The Gettysburg Formation is composed of reddish-brown to maroon, silty mudstone and shale containing thin red sandstone interbeds with several thin beds of impure limestone. According to Geyer and Wilshusen (1982), the Gettysburg Formation is moderately to well-bedded with individual beds ranging from thin to flaggy (sandstone, siltstone, and shale) and thick to massive (quartz conglomerate-fanglomerate, and limestone conglomerate) with moderately developed, moderately abundant, closely spaced, naturally occurring fractures known as joints. These joints are typically blocky, open and steeply dipping. Primary porosity occurs in the weathered portion of the formation. The joint and bedding plane openings collectively provide a secondary porosity in unweathered rock. Natural slopes are moderately steep and stable, and cut slope stability is fair to poor due to rapid weathering when exposed to moisture. The overlying soil mantle is generally thin. The shales comprising the formation are also moderately weathered to a moderate depth, whereas areas underlain by sandstones and conglomerates exhibit much less weathering. The ease of excavation (and drilling) is classified as moderately easy. The rock reportedly provides good foundation stability. Drilling rates are typically moderate to fast except in areas where the rock is adjacent to diabase intrusions making the rock harder with a slower drilling rate (Geyer and Wilshusen, 1982). The general structure of the Newark Group is a north-northwestward dipping homocline. Typical bedrock dip directions are north or northwest with an inclination ranging from 20° to 40° (Wood, 1980) (**Figure 2**).

According to the United States Department of Agriculture Soil Survey of Dauphin County, Pennsylvania, soils within approximately 1,000 feet of the drill path for HDD S3-0011 consist of 11 soils primarily sandy loams with lesser amounts of sandy loams and gravelly sandy loam and urban lands. A site map showing the spatial distribution of the various soils along with the soil profile descriptions is included as **Attachment 1**.

3.0 HYDROGEOLOGY

Bedrock geology ultimately influences the storage, transmission, and use of groundwater. Geologic factors such as rock type, intergranular porosity, rock strata inclination, faults, joints, bedding planes, and solution channels affect groundwater movement and availability. According to Wood (1980) and Low, et al. (2002), groundwater within the clastic rocks of the Gettysburg Formation within Dauphin County occurs under both unconfined (i.e., water table) and confined conditions. In general, groundwater occurs under unconfined conditions within the upper portion of the aquifer and under confined or semiconfined conditions in the deeper portions of the aquifer. The groundwater flow system was conceptualized by Wood (1980) as a series of sedimentary beds with relatively high transmissivity separated by beds exhibiting lower transmissivities. This sequence of beds exhibits different hydraulic properties that collectively act as a series of

alternating aquifers and confining or semi-confining units forming a leaky (i.e., hydraulically interconnected) multi-aquifer system (LMAS). Groundwater flow paths within the clastic rocks have both local and regional components. Locally, shallow groundwater discharges to the gaining portions of nearby streams and deeper regional groundwater flow is toward points of regional groundwater discharge such as the Susquehanna River. Groundwater divides may be different for each zone of groundwater flow and therefore may not coincide with surface water divides.

According to McGlade and Geyer (1976) and Google Earth Pro (2017), the Gettysburg Formation (Trg) is the uppermost rock unit underlying the HDD S3-0011 bore path (**Figure 2**). Based on the initial Tetra Tech geotechnical report, groundwater was encountered at 18 feet bgs in Soil Boring (SB) SB-01, 22 feet bgs in SB-02, and 12.5 feet bgs in SB-03. Groundwater was encountered in Boring SB-01 at 10 feet bgs. In the recent geotechnical report prepared by Intertek Professional Service Industries Inc., at Boring B-01, located near the northern HDD exit point overlying sandstone bedrock of the Gettysburg Formation, groundwater was encountered at 91 feet bgs in sandstone and the bedrock was cored from 25.2 feet to 100 feet bgs. At Boring B-02 drilled in the Gettysburg Formation near the southern HDD entry point, groundwater was encountered in the overburden at 15 feet bgs and bedrock was encountered at 32 feet bgs and the bedrock was cored from 32 to 100 feet bgs. Both geotechnical reports are included as **Attachment 2**.

The direction of groundwater flow within the clastic rocks of the Gettysburg Formation in Dauphin County is largely controlled by the hydraulic gradient and spatial variability of hydraulic conductivity. The groundwater flow system in the clastic rocks is highly anisotropic with the predominant flow direction parallel to the strike of the rock beds. The potential for well interference related to pumping is generally greatest for wells aligned parallel to the strike, rather than in wells drilled in the direction of bedding dip (i.e., perpendicular to the strike). The presence of diabase often acts as a barrier to flow (Becher and Root, 1981; and Wood, 1980). No groundwater modeling was performed for the area surrounding HDD S3-0011.

According to Low, et al. (2002), the depths of water-bearing zones in 322 wells completed in the Gettysburg Formation range from 5 to 900 feet bgs. Fifty percent (50%) of the 669 water-bearing zones reported were penetrated at a depth of less than 115 feet with 90% of the water-bearing zones occurring at a depth of less than 288 feet. The greatest density of water-bearing zones (0.65 per 50 feet of well depth) is from 51 to 100 feet bgs. The density of water-bearing zones encountered at depths greater than 401 feet are based on the presence of five or fewer water-bearing zones per 50-foot interval. The overall density of water-bearing zones in the Gettysburg Formation is 0.41 per 50-feet of well depth.

Well records from the PA DCNR Pennsylvania Groundwater Information System (PaGWIS) database were reviewed to identify domestic water supply and other wells located within a ½-mile radius of the proposed HDD right-of-way (ROW) boundary (PaGWIS, 2019). The search identified 25 wells within the ½-mile radius of the HDD. Of these 25 wells, one is listed as destroyed (PA Well ID 17574); and four wells are listed as abandoned (PA Well IDs 636500,

636499, 637132, 622632). The remaining wells consist of 11 domestic supply wells; three wells identified as industrial; nine wells identified as unused, which include the destroyed and abandoned wells listed above, along with four wells listed as observation wells; and one well identified as commercial. A map showing the well locations relative to the proposed HDD location is included as **Figure 3**. Based on the PaGWIS database (**Attachment 3**), nine of the wells did not have a casing size specified, two wells were 8-inch diameter, one well was 10-inch diameter, four wells were 4-inch diameter, and nine of the identified wells were completed as 6-inch-diameter open-rock wells. The reported depths of all the wells ranged from 21 to 700 feet bgs. Based solely on the PaGWIS database, the depth to bedrock ranges from 0 to 50 feet bgs, and well construction consists of 6 to 84 feet of steel casing with the open-rock portions of the wells extending from 6 feet to 700 feet bgs. Reported well yields range from 0 to 450 gallons per minute (gpm). Recorded static water level measurements range from 10 to 55 feet bgs. Based on the PaGWIS database, seven of the wells identified above were reported as being completed in the Gettysburg Formation; however, one well was identified as being in the Martinsburg Formation, which is assumed to be incorrect. According to published geologic mapping of the area, all of the identified wells should be completed exclusively in the Gettysburg Formation. The geologic formation was not specified for 17 of the 25 wells identified in the database.

In February 2019, other Sunoco subcontractors researched private water supplies within 450 feet of the White House Lane HDD. Three additional water wells were identified within the 450-foot buffer of the alignment. One of these wells was reported to be 165 feet deep. Also, one well was identified approximately 2,053 feet to the southeast from the western entry/exit point of the HDD as shown on **Attachment 3**. The reported depth of this well was 300 feet. No additional information on depth to water, well yield or pump setting was reported for these four wells.

4.0 FRACTURE TRACE ANALYSIS

Fracture traces are natural linear surficial features that are unaffected by local topographic relief and, as a result, are considered surface manifestations of concentrated high-angle bedrock fracturing. Fracture traces may be observed on aerial photographs as linear topographic features, straight stream segments, vegetation, or soil tonal variations. The occurrence of fracture traces underlying, or in close proximity to, the site were were previously mapped by Wood (1980) and McGlade and Geyer (1976).

Five fracture traces that lie within ½-mile of the S3-0011 HDD were identified, along with four other mapped fracture traces that lie outside the ½-mile radius. The approximate locations of these fracture traces, copied from Plate 1, Sheet 2, in Wood (1980) and McGlade and Geyer (1976), are depicted on the Geology Map included as **Figure 2** and the Well Location Map presented as **Figure 3**. The closest mapped fracture trace is approximately 200 feet east of the approximate midpoint of the HDD bore path at the closest point and extends northeast-southwest for approximately 3,100 feet. Another identified fracture trace is located approximately 550 feet northwest of the HDD exit point and trends northwest to southeast for approximately 3,000 feet.

Three other fracture traces are mapped to the northwest within a ½-mile radius of the proposed HDD.

5.0 GEOTECHNICAL EVALUATION

Three phases of geotechnical investigation have been completed at the White House Lane HDD S3-0011 drill site. This site was originally designated as HDD Site S3-0010 and was located approximately 295 feet west of S3-0011 in close proximity to Maple Alley. The initial three geotechnical borings (SB-01 SB-02, and SB-03) were completed along Maple Alley between October 29, 2014, and November 7, 2014. A fourth boring (SB-01) was completed on December 14, 2015, near the exit point of HDD S3-0011 and prior to initiating HDD operations. Two additional borings (B-01 and B-02) were completed in August 2017 and included coring of the bedrock. The borings were completed to investigate soil, residual soil, and bedrock conditions using hollow-stem augers with split spoons for soil sampling and a core barrel/bit for rock coring. **Attachment 2** presents two geotechnical reports documenting the borings described above, including maps depicting the boring locations, boring logs, and photographs of the rock cores obtained during the August 2017 drilling operations.

Soil Boring SB-01 was located in a gravel paved area approximately 350 feet southeast of the intersection of Maple Alley and Martin Avenue near the southern terminus of the original HDD (S3-0010). Soil Boring SB-02 was located approximately 55 feet west of the intersection of Maple Alley and Eshelman Street for the original HDD (S3-0010), and SB-03 was located in an undeveloped grass field approximately 247 feet northeast of the intersection of Maple Alley and Cherry Avenue for the original HDD (S3-0010). The generalized subsurface profile observed in SB-01 through SB-03 is described below.

- **SB-01:** Fill consisiting of possible coal fines and ash described as dark gray to black silt and sand and trace pieces of coal from ground surface to 23.9 feet bgs. Reddish-brown to dark gray clay from 23.9 to 25.5 feet bgs and fine- to coarse-grained sand and gravel from 25.5 feet to the total depth of the boring at 30 feet bgs. Groundwater was encountered at 18 feet bgs.

- **SB-02:** Twelve inches of topsoil overlying fine to medium sand with a little silt and a little fine to coarse gravel from 1.0 foot to 22.0 feet bgs; fine- to coarse-grained sand and gravel with a trace of silt from 22.0 to 26.0 feet bgs; fine- to coarse-grained sand and gravel from 26.0 feet to the total boring depth of 44.2 feet bgs. Groundwater was encountered at 22 feet bgs.

- **SB-03:** Five inches of topsoil overlying fine- to coarse-grained sand and gravel with a little silt from 0.4 foot to 26.5 feet bgs; fine- to medium-grained sand and silty clay with fine to coarse gravel from 26.5 to the total depth of the boring at 30.0 feet bgs. Groundwater was encountered at 12.5 feet bgs.

The boring logs indicate that the soil/bedrock interface was not encountered except in SB-02 where sandstone was encountered at 44.0 feet bgs, and auger refusal was encountered at 44.2 feet bgs on sandstone bedrock. According to the Unified Soil Classification System (USCS), the soils consist of 23.9 feet of silt with sand (ML) overlying 1.6 feet of soft clay (CL) over 4.5 feet of coarse sand and gravel (SM/SP/GM) in SB-01. In SB-02, approximately 22 feet of sand (SM) overlies 1 foot of coarse gravel and fine to coarse sand (SM/GM) over 16 feet of fine to coarse gravel and sand (SM/GM). In SB-03, the soils consist of 6.5 feet of 5.5 feet of sand with gravel (ML/SM) over 9.5 feet of sand and gravel (SM/GM) over 5 feet of fine to medium sand (SM) over medium sand and silty clay (SC). Groundwater was encountered at depths ranging from 12.5 feet bgs (SB-03) to 22 feet bgs (SB-02).

An additional boring, also labeled SB-01 (S3-0011), was drilled on December 14, 2015, approximately 130 feet southeast of the exit point for the S3-0011 White House Lane HDD. The generalized subsurface profile observed in SB-01 is described below.

- **SB-01:** One-half foot of asphalt and gravel overlying fill consisting of fine to coarse gravel and fine- to medium-grained and coarse-grained sand from 0.5 to 11.5 feet bgs; weathered sandstone from 11.5 to 18.0 feet bgs; partially weathered shale and sandstone from 18.0 to total depth of the boring at 21.0 feet bgs. Groundwater was encountered at 10 feet bgs.

Two additional borings (B-01 and B-02) were completed during August 2017 as part of the third phase of the geotechnical investigation. B-01 was drilled on August 10 and 11, 2017, near the exit point for S3-0011, and B-02 was drilled August 17 and 18, 2017, near the entry point. The generalized subsurface profile observed in B-01 and B-02 is described as follows:

- **B-01:** Five inches of topsoil overlying sand and silt to 12.5 feet bgs; poorly graded gravel with sand from 12.5 to 25.2 feet bgs; red sandstone and conglomeratic sandstone bedrock was encountered from 25.2 feet to the total depth of the borehole at 100 feet bgs. Groundwater was encountered at 91 feet bgs.

- **B-02:** 12.5 feet of sand and gravel fill overlying wet alluvial gravel, sand, and silt from 12.5 feet bgs to 32 feet bgs; bedrock consisting of red/brown sandstone, siltstone, and conglomeratic sandstone was encountered between 32 feet bgs and the total borehole depth of 100 feet. Groundwater was encountered at approximately 15 feet bgs.

The bedrock in both borings was described as ranging from moderately hard to hard and broken to massive. Photographs of the cores obtained from B-01 and B-02 are included in **Attachment 2**. The boring logs for B-01 and B-02 completed for HDD S3-0011 indicate that the soil/bedrock interface was encountered at 12.5 feet bgs to 32 feet bgs. Accordng to the USCS, the soils consist of 4 feet of silt with sand (ML) over 2 feet of silty sand (SM) over 6.5 feet of poorly graded sand SP) overlying 18.7 feet of poorly graded gravel with sand (GP) in B-01. In B-02,

approximately 2 feet of silty sand (SM) over 2 feet of sandy silt (ML) overlying 4 feet of silty sand (SM) over 4.5 feet of poorly graded gravel (GP-GM) over 6 feet of poorly graded gravel with sand (GP) over 5 feet of silty gravel with sand (GM). Groundwater was encountered at depths ranging from 12.5 feet bgs (B-01) to 91 feet bgs (B-02).

Please note that Skelly and Loy or RETTEW did not oversee or direct the geotechnical drilling programs associated with HDD S3-0011 including but not limited to the selection of boring locations, determination of location, determination of surface elevation, target depths, observations of rock cores during drilling operations, or preparation of boring logs. The geotechnical reports, boring logs, and core photographs that resulted from these programs were generated by other Sunoco Pipeline, L.P. contractors. Skelly and Loy and RETTEW relied on these reports and incorporated their data into the general geologic and hydrogeologic framework of the analysis of the proposed 16-inch S3-0011 HDD for this report.

6.0 FIELD OBSERVATIONS

Site reconnaissance activities were performed by Skelly and Loy geologists on January 29, 2018. These activities involved visual inspection of the entire HDD trace, but did not identify any bedrock outcrops, cuts or exposures within the White House Lane HDD drill path or in the nearby surrounding area; therefore, no structural geologic measurements were obtained for this HDD. Published structural geologic measurements of the Gettysburg Formation indicate that the bedrock strike is generally oriented between north 20° and 70° east with the inclination of bedding dip ranging from 18° to 42° northwest or west.

According to available geologic mapping, the HDD bore path is underlain by bedrock mapped as Gettysburg Formation sandstone. This mapping is consistent with Skelly and Loy's field observations and the results of the geotechnical investigations. In addition to the unnamed tributaries and identified private water supplies, no additional potential environmental receptors of concern were identified within the defined ½-mile HDD buffer area.

Two inadvertent returns (IR) occurred at HDD S3-0011 during pilot hole drilling and reaming of the pilot hole for placement of the 20-inch pipeline. IR No. 1 was located on the western side of White House Lane approximately 210 feet south of the exit point, and IR No. 2 was located on the east side of White House Lane approximately 173 feet south of the exit point. A summary of the 20-inch HDD operations is provided below.

Kirk Excavating & Construction, Inc. (Kirk) started the 20-inch pipeline pilot boring on October 17, 2017. While still in unconsolidated sand and gravel, Kirk reported a loss of approximately 5,000-gallons of drilling fluids at the end of the first day of pilot hole advancement. No evidence of an IR of the drilling fluid was found so drilling resumed on October 18, 2017. Pilot hole advancement continued until October 28, 2017 when Kirk decided to install surface casing to seal off the interface between the unconsolidated material and competent bedrock. Installation of the surface casing was completed on October 30, 2017, and pilot hole advancement was

resumed. On November 2, 2017, an IR (originally classified as a punch-out release) occurred along the northern edge of White House Lane when the pilot bit was at an estimated trajectory length of 1530 feet and at an estimated depth of 36 feet bgs. This depth corresponded to the point when the pilot bit re-entered the unconsolidated material. The discharged drilling fluid flowed from the IR location(s) to the south into a grass field in Reservoir Park. No Waters of the Commonwealth were impacted, and Kirk installed containment around the IR and recovered the discharged drilling fluid utilizing vacuum trucks. Additionally, loss control material (LCM) was installed through the drill string and pumped to the point of the IR and allowed to setup overnight. On November 3, the IR re-activated and Kirk resumed containment and recovery operations and as the pilot bit advanced would expand the containment structure to capture additional IR locations. Additional LCM was installed at the end of the day on November 3, 2017. Re-activation of the November 2 and 3 IR locations occurred between November 4 through 6 and were contained and recovered by Kirk.

On November 7, 2017, a new IR occurred on the southern side of White House Lane, which was quickly contained with silt fence and sand bags. No impacts occurred to Waters of the Commonwealth and pilot hole advancement continued. At the request of the Pennsylvania Department of Environmental Protection (PA DEP), pilot hole advancement was suspended on November 8 until PA DEP could inspect the IR locations. Kirk received approval to resume pilot hole advancement late in the day on November 9 and decided they would resume drilling on November 10, 2017. A new IR occurred on November 10, 2017 to the south of White House Lane and flowed into Wetland W-118, impacting an area approximately 30 feet by 15 feet, before the IR was observed and contained. The IR occurred when the pilot bit was at a trajectory length of 1,655 feet and a depth of 26.6 feet bgs. All drilling activities were stopped and Kirk constructed containment (silt fence and sand bags) around the new IR and began to clean-up the drilling fluid released to the wetland. PA DEP arrived on-site and instructed Kirk to complete additional clean-up activities to remove the released drilling fluid and once completed to seed and mulch the impacted portion of the wetland W-118. All drilling activities remained suspended until re-start approval was received from the PA DEP. Pilot hole advancement resumed and was completed on November 27, 2017.

Kirk completed the 30-inch ream and swab passes between November 29 and December 19, 2017 with no additional IRs or issues. The 20-inch product line was pulled through the boring on December 20, 2017.

7.0 GEOPHYSICAL SURVEY CONSIDERATIONS

No karst geology was observed during the field reconnaissance or is mapped as being present at this HDD location. Secondly, SPLP possesses a complete geologic record of the bore path geology from drilling the 20-inch borehole. The closest carbonate bedrock is mapped as the Epler Formation which is approximately 1 mile north of the HDD at its closest point. Importantly, no carbonate bedrock was observed during the site reconnaissance. Due to the occurrence of two IRs during HDD operations for the 20-inch pipeline, the Department has indicated that the

use of geophysical surveys should be considered in karst areas. Based on our experience working in karst geology, the lack of mapped karst geology along the HDD trace, and lack of continuous thick-bedded limestone units, the diabase and Gettysburg Formations are not deemed susceptible to the solution activity present in other more thickly bedded carbonate geologic formations in Pennsylvania.

RETTEW completed a multi-technique geophysical survey at the White House Lane HDD on November 15, 2018 (RETTEW, 2018). The purpose of the survey was to provide supplemental information to the geotechnical drilling programs and to detect and delineate subsurface voids or low-density zones and provide a bedrock profile. These methods and their general results are as follow.

- Seismic refraction multispectral analysis of surface waves (MASW) results indicate a general three-layer stratigraphy consisting of alluvial or residual soil mantle and a think zone of weathered rock and competent bedrock below. Apparent bedrock surface depressions and low-velocity zones below the 10,000-foot per second (fps) contour could represent deeply weathered fracture zones. These features, if fractures, could represent possible pathways for IRs during HDD operations.

- Ground Penetrating Radar (GPR) was used to detect and delineate potential voids and other anomalous features within the top 5 to 8 feet of the ground surface. Several targets known to be stormwater conveyance lines and a gasline were identified with GPR.

Results from the geophysical testing are consistent with the presence of several possible steeply dipping features (including near the location mapped by Berg, et al., 1980). These features could increase the risk of IRs and/or a loss of returns. The top-of-rock is expected to be slightly weathered at the soil-bedrock interface, with high-velocity (non-rippable) material not far below the top of rock.

8.0 CONCEPTUAL HYDROGEOLOGIC MODEL

An unnamed stream originates approximately one mile northeast of the S3-0011 HDD exit point and flows southwest toward Lisa Lake. At or near Lisa Lake, the stream enters a stormwater drainage system which flows under the Harrisburg International Airport and discharges to the Susquehanna River. It is unclear if this stream discharges to Lisa Lake. Groundwater occurring in the watershed of this unnamed stream originates as precipitation or snowmelt and infiltrates through the overburden soils. As previously described, shallow groundwater generally occurs under unconfined conditions within the upper portion of the bedrock LMAS. Based on site-specific geotechnical data (Section 5.0) and information obtained from the PaGWIS database (Section 3.0), the groundwater table occurs within the overburden and upper portion of the bedrock (10 to 91 feet bgs) proximate to the HDD path. Based on these limited site-specific data, it appears that

the groundwater table proximate to the HDD path is relatively shallow and may exist in some areas of the overburden soils that contribute flow to localized shallow groundwater discharge zones supporting the unnamed tributary to Lisa Lake and/or the Susquehanna River. The thickness of the regolith and saturated regolith varies according to the underlying geohydrologic unit and topographic setting (Low, et al., 2002).

Logs of the six geotechnical borings drilled from October 2014 through August 2017 indicated that the soil thickness near HDD S3-0011 ranges from approximately 11.5 to 44.2 feet and consists of historical fill and various soils composed of clay, silt, sand, and gravel. Recorded descriptions of the bedrock cores included red sandstone and conglomerate. Data found in the PaGWIS database (**Figure 3**) for supply wells within a ½-mile radius of the HDD trace listed measured water levels in the bedrock aquifer ranging from 10 to 55 feet bgs. Groundwater was encountered in the overburden in all four of the shallow geotechnical soil borings at depths ranging from 10 to 22 feet bgs. Depth to water measurements were obtained from Boring B-01 at 91 feet bgs in the bedrock and from Boring B-02 at 15 feet bgs in the overburden.

The Gettysburg Formation is highly anisotropic, with the predominant groundwater flow direction parallel to bedrock strike. The transport of groundwater in the fractured bedrock is generally greatest within highly permeable fractures, and the orientation of bedding planes and fractures primarily influence the direction of groundwater flow. Some site-specific evaluations of the bedrock have been completed in the area proximate to the geotechnical core borings completed along this HDD profile. No detailed characterization or groundwater flow modeling of the bedrock aquifer was performed as part of this hydrogeologic re-evaluation.

The groundwater flow direction in the overburden soils is presumed to mimic surface topography which slopes to the south and southwest toward the Susquehanna River. The geotechnical report and boring logs included as **Attachment 2** show that groundwater was present in the unconsolidated soils and the depth to water can be quite shallow proximate to the HDD path. Based on this information, the uppermost groundwater table is presumed to occur within the uppermost soils under unconfined conditions.

9.0 CONCLUSIONS

Based on published geologic and hydrogeologic information, the S3-0011 White House Lane HDD location is underlain by clastic sedimentary rocks (primarily red sandstone, siltstone, and conglomerate) of the Gettysburg Formation. Groundwater movement within these rocks is primarily through a network of interconnected secondary openings (e.g., fractures, joints, and faults) that were developed by external forces following deposition of the sedimentary beds. Geotechnical rock core observations confirm that the local bedrock ranges from fractured and broken to massive sandstone, siltstone, and conglomerate. All of the private water supply wells identified in the vicinity of the HDD are constructed in bedrock, indicating that none of the domestic wells rely on the shallow unconsolidated overburden as a source of groundwater supply. The

uppermost unconsolidated soils, weathered bedrock, and potentially the bedrock aquifer, provide groundwater discharge to the nearby unnamed stream.

The proposed 16-inch HDD profile extends entirely within both the shallow unconsolidated regolith materials and weathered to unweathered bedrock. Based on the hydro-structural characteristics of the underlying geology described in this report and the known HDD profile through shallow soils and bedrock, the White House Lane HDD site is susceptible to the inadvertent return of drilling fluids during HDD operations while entering and exiting the profile. The inclination of the entry and exit angles for the proposed 16-inch pipeline has been increased as a means to install the pipe through these protective soils, residual soils, and bedrock in closer proximity to the entry and exit points than the original, shorter, and shallower profile. According to the redesigned 16-inch HDD drilling path profile provided by Sunoco, the proposed 16-inch HDD profile is deeper than the as-built 20-inch HDD and crosses under S.R. 0230, other neighborhood streets, and several adjacent buried utiliites at depths ranging from approximately 21 feet bgs (vs. 14 feet for the as-built 20-inch HDD) to 96 feet bgs (vs. 58 feet for the 20-inch as-built HDD). From a geologic perspective, the laterally adjusted, longer and deeper profile, in conjunction with the proposed engineering controls and/or drilling BMPs, will be used to reduce the risk of an IR. Drilling BMPs are described in the Horizontal Directional Drill Analysis component of the overall re-evaluation package.

10.0 REFERENCES

Berg, T. M., W. E. Edmunds, A. R. Geyer, and others, Compilers, 1980, Geologic Map of Pennsylvania: Pennsylvania Geologic Survey, Fourth Series, Map 1, 2nd Edition, 3 sheets, Scale 1:250,000.

Berg, T. M., and C. M., Dodge, 1981, Atlas of Preliminary Geologic Quadrangle Maps of Pennsylvania, Pennsylvania Topographic and Geologic Survey, Map 61, 636 pages.

Geyer, A. R., and P. J. Wilshusen, 1982, Engineering Characteristics of the Rocks of Pennsylvania, Pennsylvania Topographic and Geologic Survey, Environmental Geology Report 1, Second Edition, 300 pages.

Google Earth Pro, 2017, Version 7.1.8.3036, December 11, 2017.

Low, Dennis J., Daniel J. Hippe, and Dawna Yannacci, 2002, Geohydrology of Southeastern Pennsylvania, U.S. Geological Survey, Water-Resources Investigations Report 00-4166, 347 pages.

McGlade, William G. and Alan R. Geyer, 1976, Environmental Geology of the Greater Harrisburg Metropolitan Area, Pennsylvania Topographic and Geologic Survey, Environmental Geology Report 4, 42 pages.

Pennsylvania Bureau of Topographic and Geologic Survey, Department of Conservation and Natural Resources, 2001, Bedrock Geology of PA, Edition: 1.0, Digital Map. Retrieved from

internet 12-11-2017; HTTP://www.dcnr.state.pa.us/topogeo/map1/bedmap.aspxDL Data: Page oexp.zip [HTTP://www.dcnr.state.pa.us/topogeo/map1/bedmap.aspx].

Pennsylvania Department of Conservation and Natural Resources, Pennsylvania Groundwater Information System (PaGWIS) database, website address: http://www.dcnr.pa.gov/Conservation/Water/Groundwater/PAGroundwaterInformationSystem/Pages/default.aspx, accessed February 12, 2019.

Pennsylvania Department of Conservation and Natural Resources, 2000, Map 13 Physiographic Provinces of Pennsylvania, Fourth Edition.

RETTEW, November 15, 2018, Geophysical Survey, Sunoco Pipeline, L.P. Pipeline Project, Horizontal Directional Drill S3-0011-White House Lane, PA-DA-0005.0000-RD-16, Lower Swatara Township, Dauphin County, Pennsylvania, 22 pages.

Root, S. I., and D. B. MacLachlan, 1999, Gettysburg-Newark Lowland, in C. H. Shultz (editor), Geology of Pennsylvania: Pennsylvania Topographic and Geologic Survey and Pittsburgh Geological Society, Special Publication 1, pages 298-305.

Taylor, L. E., and W. H. Werkheiser, 1984, Groundwater Resources of the Lower Susquehanna River Basin, Pennsylvania, Pennsylvania Topographic and Geologic Survey, Water Resources Report, W57, 130 pages.

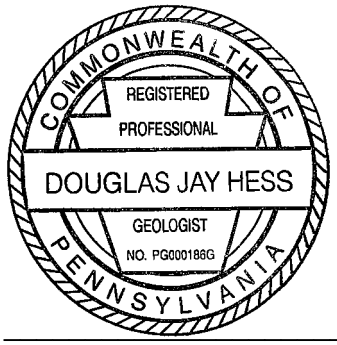
United States Department of Agriculture, 2017, Natural Resources Conservation Service, Published Soil Surveys for Pennsylvania, Cumberland County, Pennsylvania: website address https://www.nrcs.usda.gov/wps/portal/nrcs/surveylist/soils/survey/state/?stateId=PA, accessed December 6, 2017.

Wood, C. R., 1980, Groundwater Resources of the Gettysburg and Hammer Creek Formations, Southeastern, Pennsylvania, Pennsylvania Geologic Survey, 4th Series, Water Resources Report 49, 87 pages.

11.0 CERTIFICATION

The studies and evaluations presented in this report (other than Section 5.0) were completed under the direction of a licensed professional geologist (P.G.) and are covered under the P.G. seal that follows.

By affixing my seal to this document, I am certifying that the information is true and correct. I further certify that 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 herein.



Douglas J. Hess, P.G.
License No. PG-000186-G

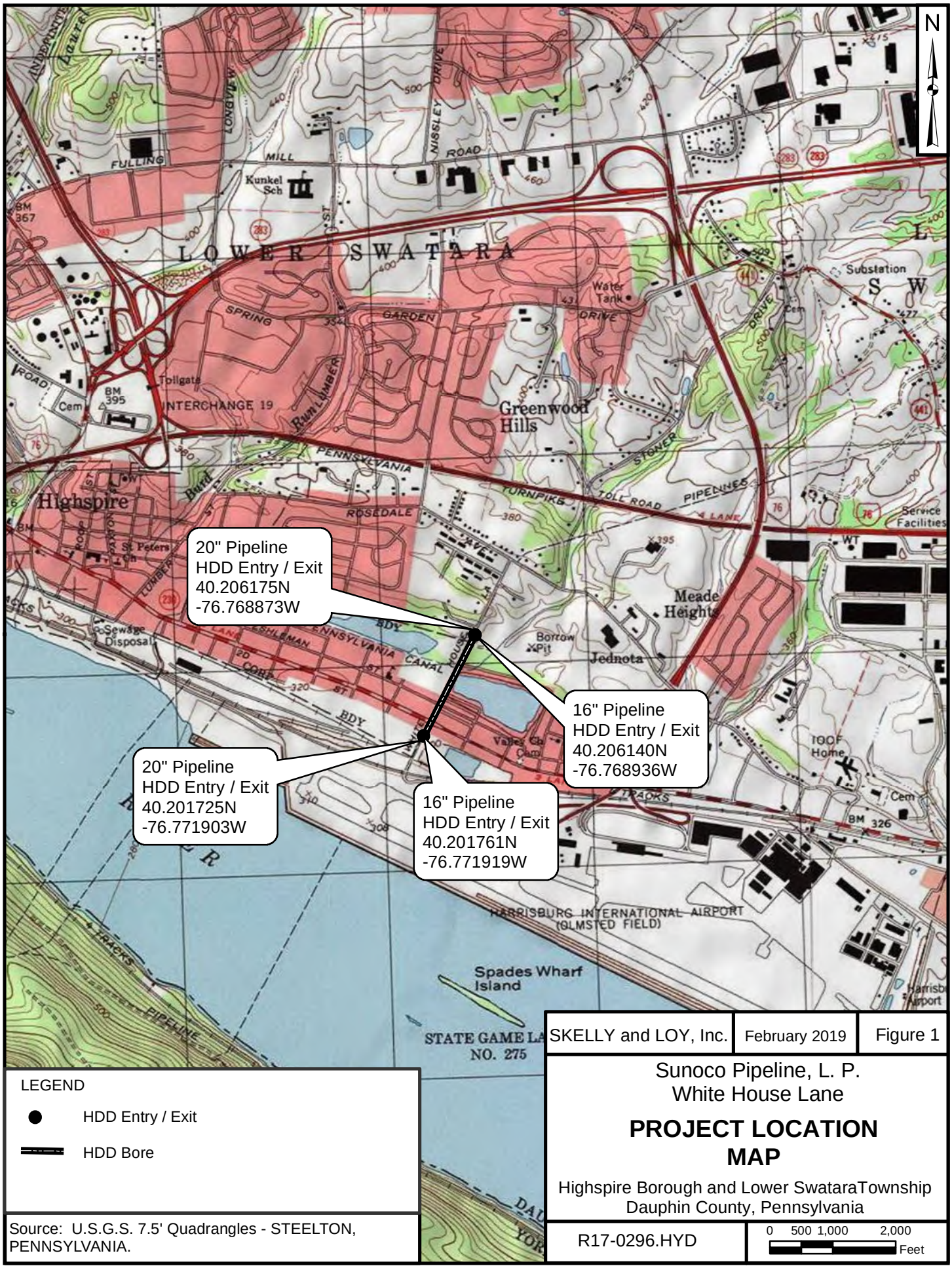
Sincerely yours,

SKELLY and LOY, Inc.

Douglas J. Hess, P.G.
Director of Groundwater
and Site Characterization
Geo-Environmental Services

Enclosures
cc: R17-0296.HYD
File: Hydro Re-Eval Rpt 16 - White House Lane DJH FINAL - REVISED by DJH 2.18.19.docx

FIGURES


N
20" Pipeline
HDD Entry / Exit
40.206175N
-76.768873W
16" Pipeline
HDD Entry / Exit
40.206140N
-76.768936W
20" Pipeline
HDD Entry / Exit
40.201725N
-76.771903W
16" Pipeline
HDD Entry / Exit
40.201761N
-76.771919W
LOWER SWATARA
Highspire
Greenwood Hills
Meade Heights
Jednota
Borton XPit
Tollgate
INTERCHANGE 19
Substation
Water Tank
Service Facilities
Sewage Disposal
St. Peters Ch
Kunkel Sch
IOOF Home
HARRISBURG INTERNATIONAL AIRPORT (OLMSTED FIELD)
Spades Wharf Island
STATE GAME LA NO. 275
PENNSYLVANIA TURNPIKE TOLL ROAD
PENNSYLVANIA CANAL
PIPELINES
TRACKS
LEGEND
HDD Entry / Exit
HDD Bore
Source: U.S.G.S. 7.5' Quadrangles - STEELTON, PENNSYLVANIA.
SKELLY and LOY, Inc.
February 2019
Figure 1
Sunoco Pipeline, L. P.
White House Lane
PROJECT LOCATION MAP
Highspire Borough and Lower SwataraTownship
Dauphin County, Pennsylvania
R17-0296.HYD
0 500 1,000 2,000
Feet

Source: Digital Bedrock Geology
"Geologic map of Pennsylvannia" (1980)

Interpreted Fracture Traces "Geologic Map of the Gettysburg & Hammer Creek Formations, SE PA" Plate 1 Part 2 - Wood 1980

N

20" Pipeline
HDD Entry / Exit
40.206175N
-76.768873W

16" Pipeline
HDD Entry / Exit
40.206140N
-76.768936W

20" Pipeline
HDD Entry / Exit
40.201725N
-76.771903W

16" Pipeline
HDD Entry / Exit
40.201761N
-76.771919W

Trg

Borough of Highspire Reservoir

Borough of Highspire Reservoir Park

Lisa Lake

Legend

HDD Centerline

GEOLOGY

Trg Gettysburg Formation

Interpreted Fracture Trace

SKELLY and LOY, Inc.	February 2019	Figure 2

Sunoco Pipeline, L.P.
White House Lane

GEOLOGY MAP

Highspire Borough and Lower SwataraTownship
Dauphin County, Pennsylvania

Job No: R17-0296.HYD

400 Feet

Source:
Interpreted Fracture Traces "Geologic Map of the Gettysburg & Hammer Creek Formations, SE PA" Plate 1 Part 2 - Wood 1980"

N

Pennsylvania Tpke

88473
88482
548162
622632

20" Pipeline
HDD Entry / Exit
40.206175N
-76.768873W

16" Pipeline
HDD Entry / Exit
40.206140N
-76.768936W

20" Pipeline
HDD Entry / Exit
40.201725N
-76.771903W

16" Pipeline
HDD Entry / Exit
40.201761N
-76.771919W

636500
637132
636499
637312
634123
634121
637313
490440
631183
631183
17839
17840
17573
17574
560427
560429
88466
560428
561173
561173
17841

Airport Connector
Lisa Lake
Harrisburg International Airport-Olmsted Field

Legend

- Proposed HDD Bore
- 0.5 Mile Radius of Proposed HDD
- Parcel Boundaries
- PAGWIS Wells with ID's
- Interpreted Fracture Trace

SKELLY and LOY, Inc.	February 2019	Figure 3

Sunoco Pipeline, L.P.
White House Lane

WELL LOCATION MAP

Highspire Borough and Lower SwataraTownship
Dauphin County, Pennsylvania

Job No: R17-0296.HYD	830 Feet

ATTACHMENT 1

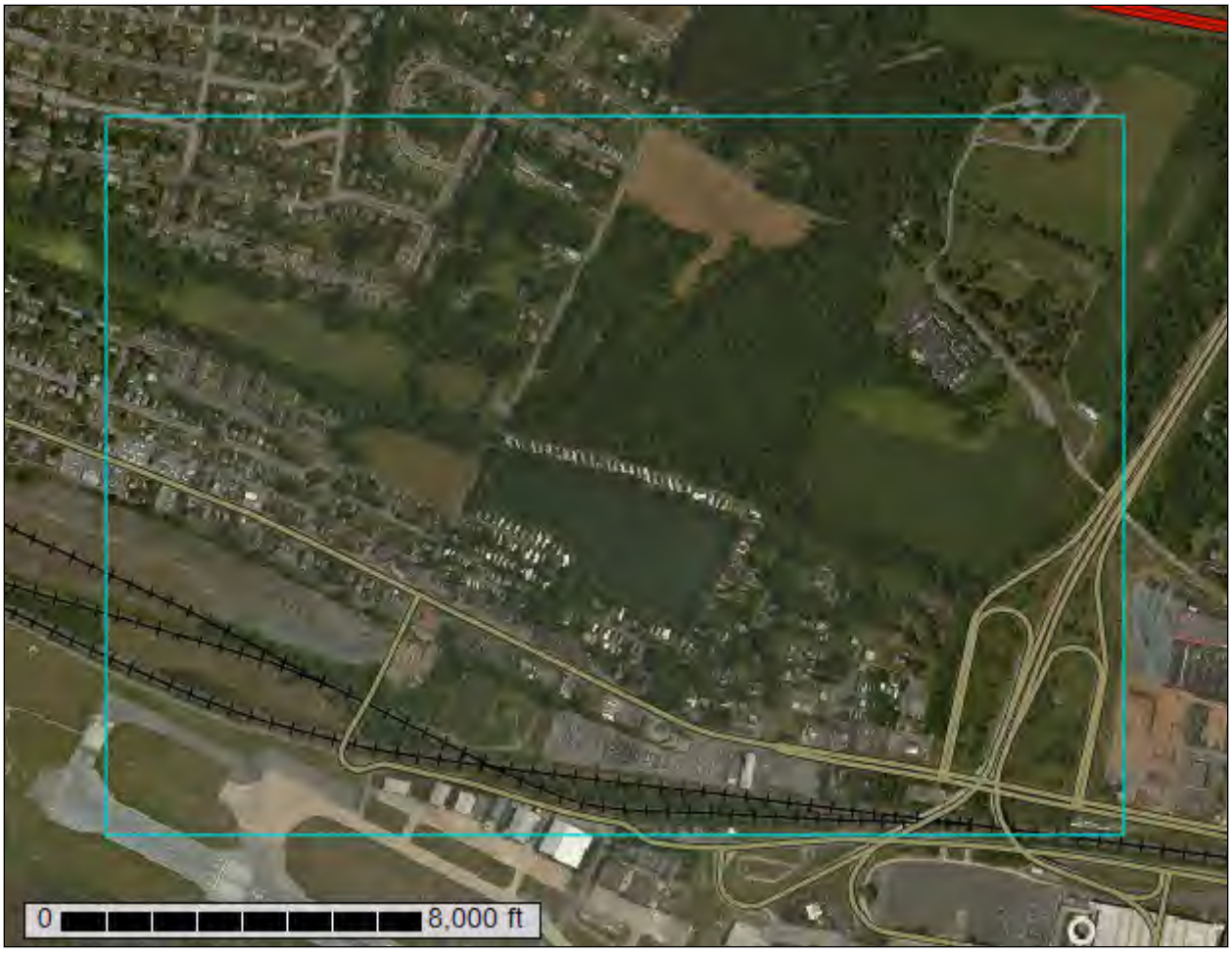
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Dauphin County, Pennsylvania



January 25, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:10,200 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 450 900 1800 2700

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Dauphin County, Pennsylvania
Survey Area Data: Version 13, Nov 27, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 15, 2013—Aug 15, 2013

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
At	Atkins silt loam	36.2	7.1%
Bc	Basher silt loam	3.9	0.8%
CnA	Chavies fine sandy loam, 0 to 3 percent slopes	23.4	4.6%
CnB2	Chavies fine sandy loam, 3 to 8 percent slopes, moderately eroded	97.8	19.3%
CnC2	Chavies fine sandy loam, 8 to 15 percent slopes, moderately eroded	34.4	6.8%
GP	Gravel pits	29.0	5.7%
LeB2	Lawrenceville very fine sandy loam, 2 to 8 percent slopes, moderately eroded	29.2	5.8%
LrC2	Lewisberry gravelly sandy loam, 8 to 15 percent slopes, moderately eroded	2.2	0.4%
Tg	Tioga fine sandy loam, high bottom	122.0	24.1%
Ua	Urban land, alluvial materials	11.3	2.2%
Ub	Urban land, limestone materials	86.6	17.1%
W	Water	31.3	6.2%
Totals for Area of Interest		**507.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called

noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can

be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Dauphin County, Pennsylvania

At—Atkins silt loam

Map Unit Setting

National map unit symbol: l4mr
Elevation: 200 to 3,000 feet
Mean annual precipitation: 32 to 55 inches
Mean annual air temperature: 46 to 59 degrees F
Frost-free period: 120 to 214 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Atkins and similar soils: 85 percent
Minor components: 14 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Atkins

Setting

Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Acid alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 30 inches: silt loam
H3 - 30 to 60 inches: gravelly silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 60 to 99 inches to lithic bedrock
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Barbour

Percent of map unit: 6 percent
Hydric soil rating: No

Philo

Percent of map unit: 6 percent
Hydric soil rating: No

Saprists

Percent of map unit: 2 percent
Landform: Depressions
Hydric soil rating: Yes

Bc—Basher silt loam

Map Unit Setting

National map unit symbol: l4mt
Elevation: 200 to 1,000 feet
Mean annual precipitation: 32 to 46 inches
Mean annual air temperature: 45 to 57 degrees F
Frost-free period: 120 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Basher and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Basher

Setting

Landform: Flood plains
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loamy alluvium derived from shale and siltstone

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 27 inches: silt loam
H3 - 27 to 42 inches: gravelly loam
H4 - 42 to 60 inches: very gravelly fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 72 to 99 inches to
Natural drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B/D
Hydric soil rating: No

Minor Components

Atkins

Percent of map unit: 7 percent
Landform: Flood plains
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Barbour

Percent of map unit: 3 percent
Hydric soil rating: No

CnA—Chavies fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: l4nl
Elevation: 300 to 1,000 feet
Mean annual precipitation: 35 to 55 inches
Mean annual air temperature: 45 to 59 degrees F
Frost-free period: 120 to 205 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Chavies and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chavies

Setting

Landform: Terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and siltstone

Typical profile

H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 30 inches: fine sandy loam
H3 - 30 to 66 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Tioga, high bottom

Percent of map unit: 5 percent
Hydric soil rating: No

Captina

Percent of map unit: 5 percent
Hydric soil rating: No

CnB2—Chavies fine sandy loam, 3 to 8 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: l4nm
Elevation: 300 to 1,000 feet
Mean annual precipitation: 35 to 55 inches
Mean annual air temperature: 45 to 59 degrees F
Frost-free period: 120 to 205 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Chavies and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chavies

Setting

Landform: Terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and siltstone

Typical profile

H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 30 inches: fine sandy loam
H3 - 30 to 66 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Tioga, high bottom

Percent of map unit: 5 percent
Hydric soil rating: No

Captina

Percent of map unit: 5 percent
Hydric soil rating: No

CnC2—Chavies fine sandy loam, 8 to 15 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: l4nn
Elevation: 300 to 1,300 feet
Mean annual precipitation: 35 to 55 inches
Mean annual air temperature: 45 to 59 degrees F
Frost-free period: 120 to 190 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Chavies and similar soils: 90 percent
Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chavies

Setting

Landform: Terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and siltstone

Typical profile

H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 30 inches: fine sandy loam
H3 - 30 to 66 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Captina

Percent of map unit: 5 percent
Hydric soil rating: No

Bedington

Percent of map unit: 5 percent
Hydric soil rating: No

GP—Gravel pits

Map Unit Setting

National map unit symbol: svq0
Mean annual precipitation: 36 to 46 inches
Mean annual air temperature: 46 to 56 degrees F
Frost-free period: 135 to 170 days

Farmland classification: Not prime farmland

Map Unit Composition

Pits, shale: 50 percent
Pits, gravel: 50 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pits, Shale

Typical profile

C - 0 to 1 inches: channers
R - 1 to 2 inches: bedrock

Properties and qualities

Slope: 0 to 40 percent
Depth to restrictive feature: 0 to 2 inches to paralithic bedrock
Natural drainage class: Excessively drained
Runoff class: Medium

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8e
Hydric soil rating: No

Description of Pits, Gravel

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8e
Hydric soil rating: No

LeB2—Lawrenceville very fine sandy loam, 2 to 8 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: l4pd
Elevation: 300 to 850 feet
Mean annual precipitation: 40 to 52 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 140 to 205 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Lawrenceville and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lawrenceville

Setting

Landform: Upland slopes

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Parent material: Silty eolian deposits

Typical profile

H1 - 0 to 8 inches: very fine sandy loam
H2 - 8 to 25 inches: silt loam
H3 - 25 to 44 inches: silt loam
H4 - 44 to 74 inches: channery silt loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 24 to 38 inches to fragipan; 72 to 96 inches to paralithic bedrock
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Tioga, high bottom

Percent of map unit: 5 percent
Hydric soil rating: No

Duncannon

Percent of map unit: 5 percent
Hydric soil rating: No

LrC2—Lewisberry gravelly sandy loam, 8 to 15 percent slopes, moderately eroded

Map Unit Setting

National map unit symbol: l4ph
Elevation: 300 to 1,500 feet
Mean annual precipitation: 38 to 48 inches
Mean annual air temperature: 48 to 57 degrees F
Frost-free period: 165 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Lewisberry and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lewisberry

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, nose slope
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Residuum weathered from conglomerate and/or residuum weathered from sandstone

Typical profile

H1 - 0 to 12 inches: gravelly sandy loam
H2 - 12 to 46 inches: gravelly sandy loam
H3 - 46 to 62 inches: extremely gravelly sandy loam
H4 - 62 to 72 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 48 to 84 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Steinsburg

Percent of map unit: 5 percent
Landform: Hillsides
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Penn

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope, nose slope

Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Arendtsvillle
Percent of map unit: 5 percent
Hydric soil rating: No

Tg—Tioga fine sandy loam, high bottom

Map Unit Setting
National map unit symbol: l4q3
Elevation: 300 to 3,000 feet
Mean annual precipitation: 35 to 55 inches
Mean annual air temperature: 45 to 59 degrees F
Frost-free period: 130 to 205 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Tioga and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tioga

Setting
Landform: Flood plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Acid alluvium derived from sedimentary rock

Typical profile
H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 60 inches: fine sandy loam
H3 - 60 to 69 inches: gravelly fine sandy loam

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very high (about 12.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Lindside

Percent of map unit: 5 percent
Hydric soil rating: No

Tioga, flooded

Percent of map unit: 5 percent
Hydric soil rating: No

Philo

Percent of map unit: 5 percent
Hydric soil rating: No

Ua—Urban land, alluvial materials

Map Unit Setting

National map unit symbol: l4q4
Elevation: 300 to 850 feet
Mean annual precipitation: 36 to 52 inches
Mean annual air temperature: 44 to 57 degrees F
Frost-free period: 130 to 205 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 85 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Pavement, buildings and other artifically covered areas

Minor Components

Tioga

Percent of map unit: 5 percent
Hydric soil rating: No

Ub—Urban land, limestone materials

Map Unit Setting

National map unit symbol: l4q5
Elevation: 460 to 1,500 feet
Mean annual precipitation: 30 to 46 inches
Mean annual air temperature: 44 to 57 degrees F
Frost-free period: 130 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 90 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Pavement, buildings and other artifically covered areas

Minor Components

Hagerstown

Percent of map unit: 5 percent
Hydric soil rating: No

W—Water

Map Unit Setting

National map unit symbol: svq1
Mean annual precipitation: 36 to 50 inches
Mean annual air temperature: 46 to 59 degrees F
Frost-free period: 120 to 214 days
Farmland classification: Not prime farmland

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Setting

Parent material: Rivers streams ponds

Properties and qualities

Runoff class: Negligible
Frequency of ponding: Frequent

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

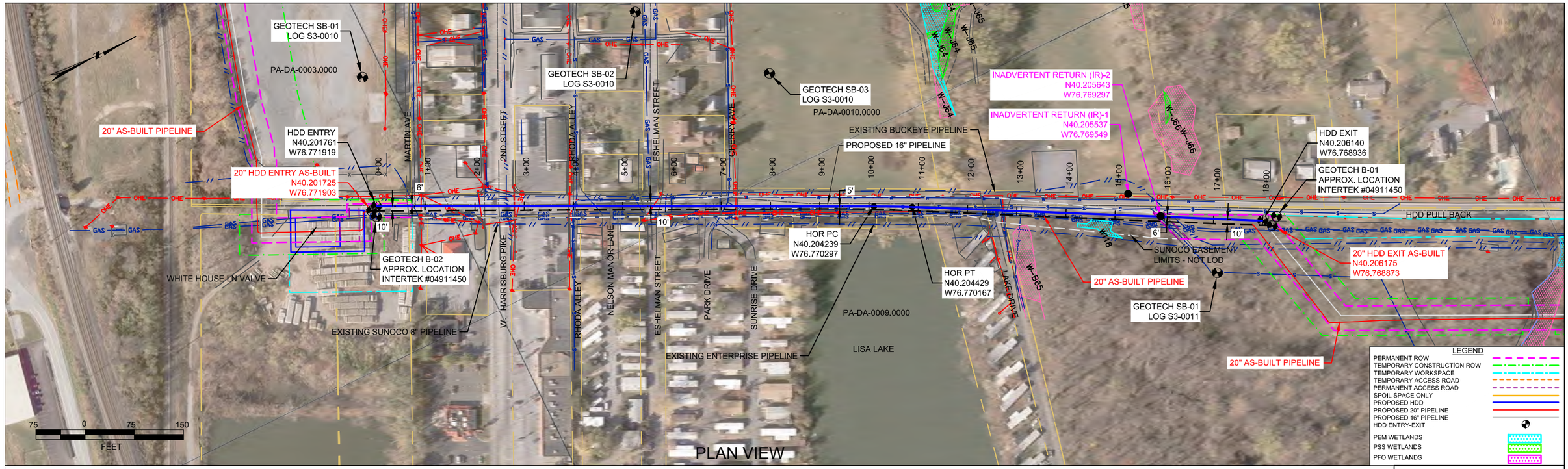
United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

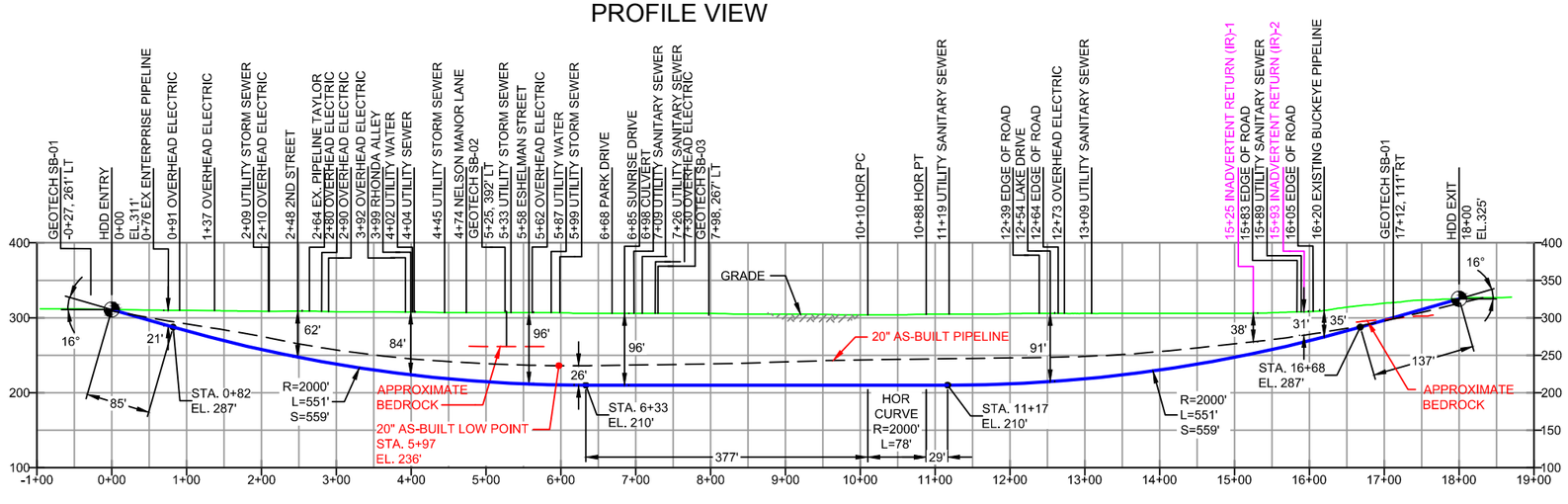
United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

ATTACHMENT 2

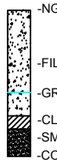


DAUPHIN COUNTY, PENNSYLVANIA - LOWER SWATARA TOWNSHIP
S3-0011-16

PROFILE VIEW



GEOTECH SB-01



-NG EL. 311'
-FILL (0.0' - 23.9')
-GROUNDWATER (18.0')
-CL (23.9' - 25.5')
-SM / GM (25.5' - 30.0')
-COMPLETION DEPTH EL. 281'

GEOTECH SB-02

-NG EL. 308'
-TOPSOIL (0' - 1.0')
-SM (1.0' - 22.0')
-GROUNDWATER (19.0')
-SM / GM (22.0' - 44.0')
-SANDSTONE (44.0' - 44.2')
-AUGER REFUSAL (44.2')
-COMPLETION DEPTH EL. 264'

GEOTECH SB-03

-NG EL. 304'
-TOPSOIL (0' - 0.4')
-ML / SM (0.4' - 6.5')
-SM (6.5' - 12.0')
-GROUNDWATER (12.5')
-SM / GM (12.0' - 21.5')
-SM (21.5' - 26.5')
-SC (26.5' - 30.0')
-COMPLETION DEPTH EL. 274'

NOTE: REFER TO TEST BORING LOG S3-0010 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH SB-01

-NG EL. 311'
-ASPHALT AND GRAVEL (0' - 0.5')
-FILL (0.5' - 11.5')
-GROUNDWATER (10.0')
-SC (11.5' - 18.0')
-SANDSTONE (18.0' - 21.0')
-AUGER REFUSAL (21.0')
-COMPLETION DEPTH EL. 290'

NOTE: REFER TO TEST BORING LOG S3-0011 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH B-01

-NG EL. 325'
-TOPSOIL (0' - 0.42')
-ALLUVIUM-SILT W/ SAND ML (0.42' - 4.0')
-ALLUVIUM-SILTY SAND SM (4.0' - 6.0')
-ALLUVIUM-SAND SP (6.0' - 12.5')
-ALLUVIUM-GRAVEL GP (12.5' - 25.25')
-GROUNDWATER (91.0')
-SANDSTONE/SILTSTONE (25.25' - 100.0')
-BORING TERMINATED EL.225'

NOTE: REFER TO TEST BORING LOG B-01 INTERTEK PROJECT #04911450 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH B-02

-NG EL. 311'
-FILL SM (0.0' - 2.0')
-FILL ML (2.0' - 4.0')
-FILL SM (4.0' - 8.0')
-PROBABLE FILL GP-GM (8.0' - 12.5')
-GROUNDWATER (15.0')
-PROBABLE ALLUVIUM GRAVEL GP (12.5' - 18.5')
-ALLUVIUM GRAVEL GM (18.5' - 23.5')
-ALLUVIUM SILTY SAND W/ GRAVEL SM (23.5' - 28.0')
-ALLUVIUM CLAYEY GRAVEL W/ SAND GC (28.0' - 32.0')
-SANDSTONE/SILTSTONE (32.0' - 100.0')
-BORING TERMINATED EL.211'

NOTE: REFER TO TEST BORING LOG B-02 INTERTEK PROJECT #04911450 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=): 1800'
   HDD PIPE LENGTH (S=): 1824'
   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.
12. SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
13. SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

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

ES-4.06	TO	ES-4.07	EROSION & SEDIMENT PLAN	
SHEET 4	TO	SHEET 4	AERIAL SITE PLAN	
DWG NO		DWG NO	DESCRIPTION	

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP3	DESIGN CHANGE - INCREASED DEPTH OF DRILL, ADDED GEOTECH DATA	MRS	12/14/18	RMB	12/14/18	AMC	12/14/18
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MRS	10/21/16	RMB	10/21/16	AAW	10/21/16
EP1	REVISED PER PADEP COMMENTS	DLM	05/09/16	RMB	05/09/16	AAW	05/09/16
EP		DLM	02/26/16	RMB	02/26/16	AAW	02/26/16
B	ADDED GEOTECH INFO	MRS	09/18/15	RMB	09/18/15	AAW	09/18/15
A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15

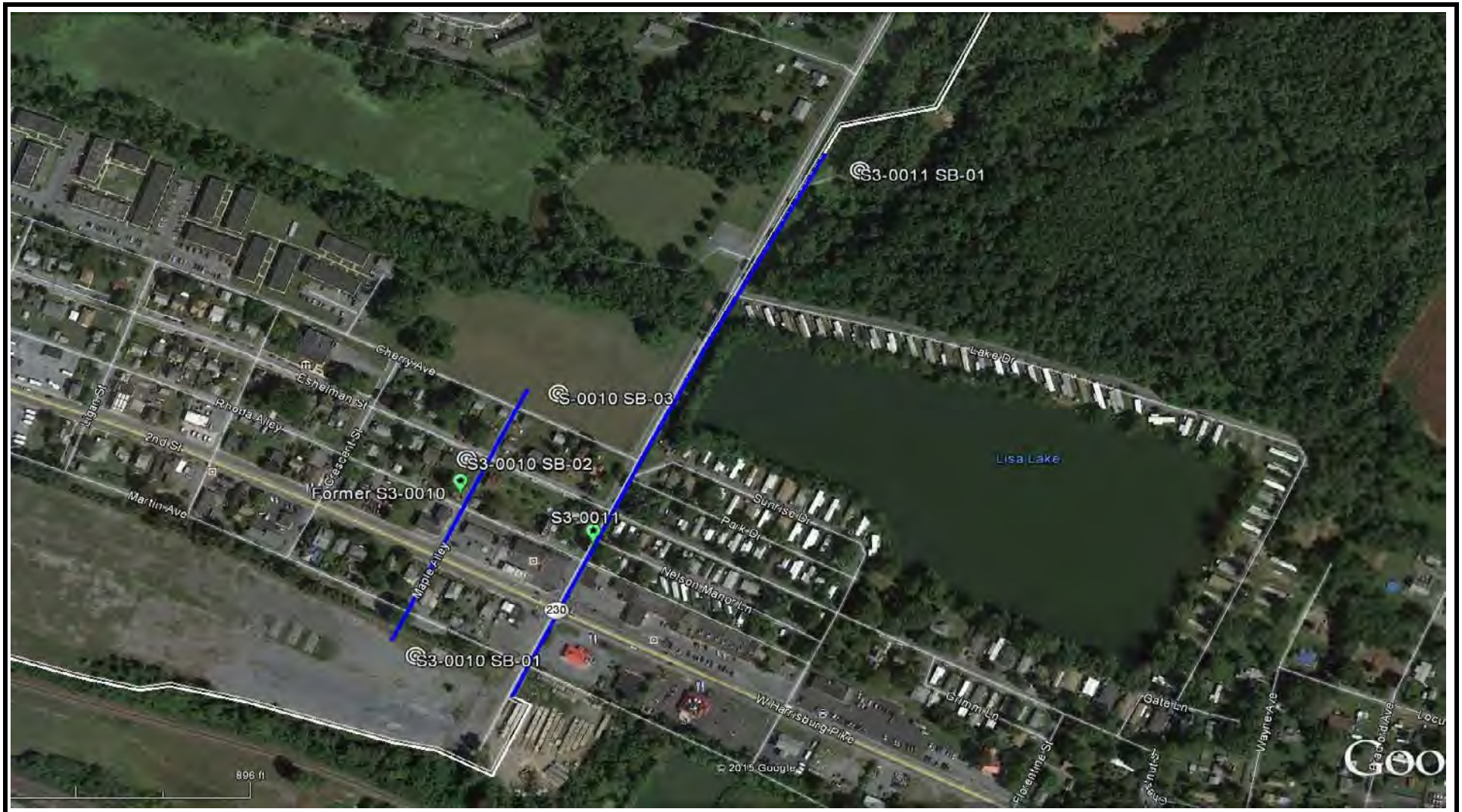
Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
WHITE HOUSE LANE
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150' | DWG. NO PA-DA-0005.0000-RD-16



LEGEND:

Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0011 AND FORMER S3-0010
DAUPHIN COUNTY, HIGHSPIRE TOWHSHIP, PA
SUNOCO PENNSYLVANIA PIPELINE PROJECT

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

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	WHITE HOUSE LANE, HIGHSPIRE, PA (HARRISBURG AIRPORT PROPERTY)		Page 1 of 1
HDD No.:	S3-0010	Dates(s) Drilled: 10-29-14	Inspector: E. WATT
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 18.0	Total Depth (ft): 30.0
Boring Location Coordinates:		40°12'7.25"N	76°46'22.09"W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
							NO DISCERABLE TOPSOIL PRESENT.					
1	3.0	5.0	0.0		18	HISTORIC FILL, ML?	FILL MATERIAL (ASH/COAL SPOILS?): DARK GRAY TO BLACK FINE	2	3	4	7	**7**
							SAND, LITTLE SILT.					
2	8.0	10.0			10		FILL MATERIAL (ASH/COAL SPOILS?): DARK GRAY TO BLACK SILT	1	1	1	2	**2**
							WITH SOME FINE SAND, TRACE PIECES OF (COAL?)					
3	13.0	15.0			19		FILL MATERIAL (ASH/COAL SPOILS?): DARK GRAY TO BLACK SILT	1	1	1	1	**2**
							AND FINE SAND, TRACE PIECES OF (COAL?) USCS: ML?					
4	18.0	20.0			24		FILL MATERIAL (ASH/COAL SPOILS?): DARK GRAY TO BLACK SILT	1	1	1	2	**2**
				23.9			AND FINE SAND.					
5	23.0	25.0	23.9		24	CL	REDDISH BROWN TO DARK GRAY CLAY (VERY SOFT), SATURATED,	1	1	1	5	**2**
				25.5			(USCS: CL).					
6	28.0	30.0	25.5		24	SM/ SP/G M	BROWN TO ORANGE BROWN FINE TO COARSE SAND AND F-C	3	8	18	35	**26**
				30.0			GRAVEL, WITH A LITTLE SILT.					
							WET ON SPOON AT 18'.					
							CAVED AT 22.5', WATER LEVEL ON CAVE AT 22.5'.					

Notes/Comments:

Pocket Pentrometer Testing

NOT TESTABLE, DOES NOT BEHAVE LIKE SILT/CLAY.

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

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

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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	ESHELMAN STREET AND MAPLE ALLEY, HIGHSPIRE, PA		Page 1 of 1
HDD No.:	S3-0010	Dates(s) Drilled: 11-06-14	Inspector: E. WATT
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 19.0	Total Depth (ft): 44.2
Boring Location Coordinates:		40°12'12.73"N	76°46'20.41"W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	1.0			TOPSOIL (12")					
1	3.0	5.0	1.0		10		BROWN FINE TO MEDIUM SAND WITH A LITTLE SILT, AND A TRACE	2	6	4	5	**10**
							FINE TO COARSE GRAVEL.					
2	8.0	10.0			10		BROWN FINE TO MEDIUM SAND WITH A LITTLE SILT, WITH A LITTLE	10	16	16	15	**32**
						SM	FINE TO COARSE GRAVEL.					
3	13.0	15.0			7		BROWN AND REDDISH BROWN FINE TO MEDIUM SAND WITH A LITTLE	27	23	20	18	**43**
							SILT, AND A LITTLE FINE TO COARSE GRAVEL.					
4	18.0	20.0			12		VARYING SHADES OF BROWN MEDIUM TO COARSE SAND WITH A	1	22	40	47	**62**
				22.0			LITTLE SILT AND SOME FINE TO COARSE GRAVEL.					
5	23.0	25.0	22.0		19	SM/ GM	BROWN, ORANGE BROWN, GREENISH BROWN AND MAROON FINE	7	24	33	38	**57**
				26.0			TO COARSE GRAVEL AND FINE TO COARSE SAND, TRACE SILT.					
6	28.0	28.2			4		REDDISH BROWN TO MAROON FINETO COARSE SANDSTONE	50/2"				**>50**
							GRAVEL AND FINE TOMEDIUM SAND, SOME SILT.					
7	33.0	33.4			5	SM/ GM	MAROON FINE SAND AND UNWEATHERED SANDSTONE	50/5"				**>50**
							GRAVEL, SOME SILT.					
8	38.0	38.6			7		MAROON SILTY FINE SAND AND UNWEATHERED SANDSTONE	40	50/1"			**>50**
							GRAVEL.					
9	43.0	43.4		44.2	3		MARRON TO LIGHT GRAY PARTIALLY WEATHERED SANDSTONE.	50/5"				**>50**
							AUGER REFUSAL AT 44.2'.					
							WET ON SPOON AT 22'.					
							WATER LEVEL THROUGH AUGERS AT 19'.					
							CAVED AT 27', WATER LEVEL ON CAVE AT 16'.					

Notes/Comments:
Pocket Pentrometer Testing

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

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

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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	CHERRY AVENUE, HIGHSPIRE, PA		Page 1 of 1
HDD No.:	S3-0010	Dates(s) Drilled: 11-07-14	Inspector: E. WATT
Boring No.:	SB-03	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 12.5	Total Depth (ft): 30.0
Boring Location Coordinates:		40°12'14.58"N	76°46'17.40"W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.4			TOPSOIL (5")					
1	3.0	5.0	0.4		5	ML/ SM	BROWN SILT AND FINE TO MEDIUM SAND WITH SOME FINE TO COARSE	10	22	18	12	**40**
				6.5			GRAVEL.					
2	8.0	10.0	6.5		17	SM	BROWN TO GRAYISH BROWN FINE TO COARSE SAND WITH A LITTLE	7	9	10	12	**19**
				12.0			FINE TO COARSE GRAVEL, AND SOME SILT.					
3	13.0	15.0	12.0		16	SM/ GM	BROWN TO GRAYISH BROWN FINE TO COARSE SAND AND FINE	1	21	24	21	**45**
							TO COARSE GRAVEL, LITTLE SILT.					
4*	18.0	20.0		21.5	6		*MULTI-COLORED FINE TO COARSE GRAVEL.	1	1	1	2	**2**
5	23.0	25.0	21.5		12	SM	REDDISH BROWN FINE TO MEDIUM WITH A LITTLE SILT, AND A LITTLE	20	50/6"			**>50**
				26.5			FINE TO COARSE SANDSTONE GRAVEL.					
6	28.0	28.2			4	SC	REDDISH BROWN FINE TO MEDIUM SAND AND SILTY CLAY, WITH A	25	50/5"			**>50**
				30.0			LITTLE FINE TO COARSE SANDSTONE GRAVEL (USCS: SC).					
							WET ON SPOON AT 13'.					
							WATER LEVEL THROUGH AUGERS AT 12.5'.					
							CAVED AT 14', WATER LEVEL ON CAVE AT 11'.					
							*TWO FEET OF HEAVE AT SAMPLE 4, HEAVE WASHED OUT. SAMPLE					
							AND BLOW COUNTS MAY NOT BE REPRESENTATIVE.					

Notes/Comments:
Pocket Pentrometer Testing

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

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

TETRA TECH
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Newark, Delaware 19713
302.738.7551
fax: 302.454.5988

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	256 WHITE HOUSE LAND, HIGHSPIRE, PA		Page 1 of 1
HDD No.:	S3-0011	Dates(s) Drilled: 12-14-15	Inspector: J. COSTELLO
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller: E. OGDEN
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 10.0	Total Depth (ft): 21.0
Boring Location Coordinates:		40°12'20.82"N	76°46'7.48"W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.5			OLD DRIVEWAY - ASPHALT AND GRAVEL.					
1	3.0	5.0	0.5		10	GM (HISTORICAL FILL)	GRAY AND BROWN F-C GRAVEL AND F-M SAND,LITTLE SILT.	5	15	11	10	**26**
							(HISTORIC FILL)					
2	8.0	10.0			13		GRAY AND BROWN F-C GRAVEL AND F-C SAND, WITH A LITTLE SILT	16	13	12	12	**25**
				11.5			(HISTORIC FILL)					
3	13.0	14.4	11.5		10	SC	REDDISH BROWN WEATHERED SANDSTONE, WEALTHERED TO A	10	50	3/5"		**>50**
				18.0			F-C SAND AND SILTY CLAY. (USCS: SC)					
4	18.0	18.6	18.0	21.0	14		REDDISH BROWN PARTIALLY WEATHERED SHALE OR SANDSTONE.	25	50/1"			**>50**
							AUGER REFUSAL AT 21'.					
							WATER LEVEL THROUGH AUGERS AT 10'.					
							CAVED AND WET AT 9.5'.					

Notes/Comments:
Pocket Pentrometer Testing
S4: > 4 TSF

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

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

GEOTECHNICAL LABORATORY TESTING SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0010 (Former) and S3-0011

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.) From	Depth of Sample (ft.) To	Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318) Liquid Limit, %	Atterburg Limits (ASTM D4318) Plastic Limit, %	Atterburg Limits (ASTM D4318) Plasticity Index, %	USCS Classif. (ASTM D2487)
S3-0010	SB-01	1	3.0	5.0	9.9	16.0	-	-	-	-
		2	8.0	10.0	44.2	77.7	-	-	-	-
		3	13.0	15.0	45.7	58.9	NV	NP	NP	ML
		4	18.0	20.0	65.5	62.5	-	-	-	-
		5	23.0	25.0	47.9	98.7	47	26	21	CL
		6	28.0	30.0	11.7	13.4	-	-	-	-
	SB-02	2	8.0	10.0	5.2	12.0	-	-	-	-
		4	18.0	20.0	9.0	11.9	-	-	-	-
		6	28.0	28.2	12.4	21.6	-	-	-	-
		7	33.0	33.4	12.4	28.9	-	-	-	-
		8	38.0	38.6	9.7	33.2	-	-	-	-
	SB-03	2	8.0	10.0	13.3	27.5	-	-	-	-
		3	13.0	15.0	10.3	11.8	-	-	-	-
		5	23.0	25.0	12.9	16.3	-	-	-	-
		6	28.0	28.2	13.1	46.7	30	20	10	SC
S3-0011	SB-01	1	3.0	5.0	5.4	16.7	-	-	-	-
		2	8.0	10.0	9.0	12.0	-	-	-	-
		3	13.0	14.4	10.0	47.1	26	22	14	SC

Notes:

1) Sample depths based on feet below grade at time of exploration.

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0010 (Former) and S3-0011

HDD No.	NAME	BORING NO.	REGIONAL GEOLOGY DESCRIPTION	GENERAL TOPOGRAPHIC SETTING	BEDROCK FORMATION	GENERAL ROCK TYPE	APPROX MAX FM THICKNESS (FT)	DEPTH TO ROCK (Ft bgs) based on nearby well drilling logs	NOTES / COMMENTS
S3-0010	Maple Alley	SB-01	**Gettysburg Fm** - reddish-brown to maroon silty mudstone and shale and soft, red-brown, medium- to fine-grained sandstone, with minor amounts of yellowish-brown shale and sandstone and thin beds of impure limestone.	Level low area (adj. to airport)	Gettysburg Fm	Silty mudstone-shale-sandstone w/ some impure limestone	16,000	25-30	
		SB-02							
		SB-03							
S3-011	White House Lane	SB-01		Level area near edge of treeline					

Note : Source of well log data - http://www.dcnr.state.pa.us/topogeo/groundwater/pagwis/records/index.htm. All other sources as referenced in comments section.

FIELD DESCRIPTION AND LOGGING SYSTEM FOR SOIL EXPLORATION

GRANULAR SOILS

(Sand, Gravel & Combinations)

Density	***N (blows)****
Very Loose	5 or less
Loose	6 to 10
Medium Dense	11 to 30
Dense	31to 50
Very Dense	51 or more

Relative Proportions

Description Term	*Percent*
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

Particle Size Identification

Boulders	8 in. diameter or more	
Cobbles	3 to 8 in. diameter	
Gravel	Coarse (C)	3 in. to ¾ in. sieve
	Fine (F)	¾ in. to No. 4 sieve
Sand	Coarse (C)	No. 4 to No. 10 sieve (4.75mm-2.00mm)
	Medium (M)	No. 10 to No. 40 sieve (2.00mm – 0.425mm)
	Fine (F)	No. 40 to No. 200 sieve (0.425 – 0.074mm)
Silt/Clay	Less Than a No. 200 sieve (<0.074mm)	

COHESIVE SOILS

(Silt, Clay & Combinations)

Consistency	***N (blows)****
Very Soft	3 or less
Soft	4 to 5
Medium Stiff	6 to 10
Stiff	11 to 15
Very Stiff	16 to 30
Hard	31 or more

Plasticity

Degree of Plasticity	*Plasticity Index*
None to Slight	0 - 4
Slight	5 - 7
Medium	8- 22
High to Very High	> 22

ROCK

(Rock Cores)

Rock Quality Designation (RQD), %	***Rock Quality Description***
0-25	Very Poor
25-50	Poor
50-75	Fair
75-90	Good
90-100	Excellent

N - Standard Penetration Resistance. Driving a 2.0" O.D., 1-3/8" I.D. sampler a distance of 18 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. The number of hammer blows to drive the sampler through each 6 inch interval is recorded; the number of blows required to drive the sampler through the final 12 inch interval is termed the Standard Penetration Resistance (SPR) N-value. For example, blow counts of 6/8/9 (through three 6-inch intervals) results in an SPR N-value of 17 (8+9).

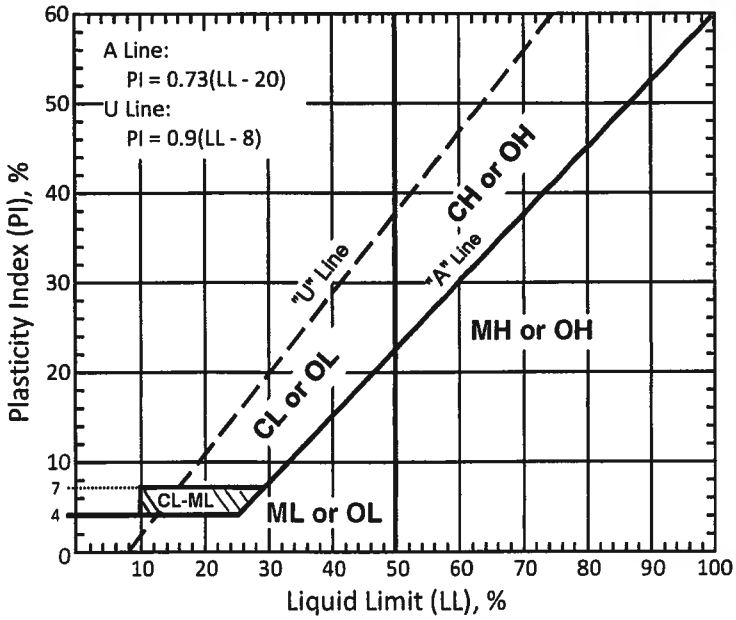
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]

Major Divisions			Group Symbols	Typical Descriptions	Laboratory Classifications		
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels More than half of coarse fraction is larger than No. 4 sieve	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Determine Percentage of sand and gravel from grain size curve. Depending on Percentage of fines (fraction smaller than No. 200 sieve), coarse-grained soils are classified as follows: Less than 5 percent GW, GP, SW, SP; More than 12 percent GM, GC, SM, SC; 5 to 12 percent Borderline cases requiring dual symbols[1]	$C_u=\frac{D_{60}}{D_{10}}$ greater than 4: $C_c=\frac{(D_{30})2}{D_{10} \times D_{60}}$ between 1 and 3	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting C_u or C_c requirements for GW	
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits below A Line or I_p less than 4	Limits plotting in hatched zone with I_p between 4 and 7 are borderline cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits above A line with I_p greater than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 Sieve)	Clean sands (Little or no fines)	SW	Well graded sands, gravely sands, little or no fines		$C_u=\frac{D_{60}}{D_{10}}$ greater than 6 $C_c=\frac{(D_{30})2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands, gravelly sands, little or no fines		Not meeting C_u or C_c requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures		Atterberg limits below A Line or I_p less than 4	Limits Plotting in hatched zone with I_p between 4 and 7 are borderline cases requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits above A line with I_p greater than 7	

Major Divisions		Group Symbols	Typical Descriptions
Fine–grained soils (More than half of material is smaller than No. 200 sieve)	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 sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
	Highly organic soils	Pt	Peat and other highly organic soils

For soils plotting nearly on A line use dual symbols i.e ., I_p = 29.5, w_L=60 gives CH-MH. When w_L is near 50 use CL-CH or ML-MH. Take near as ± 2 percent.



(1) Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC. well-graded gravel-sand mixture with clay binder.

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FIGURE 1: Site Vicinity Map

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Created using PA DCNR Map Viewer

Map created on Fri Sep 1 2017

FIGURE 2: Boring Location Plan
White House Lane - PPP4
DPS PO# 20170804-5
PSI Proj # 04911450

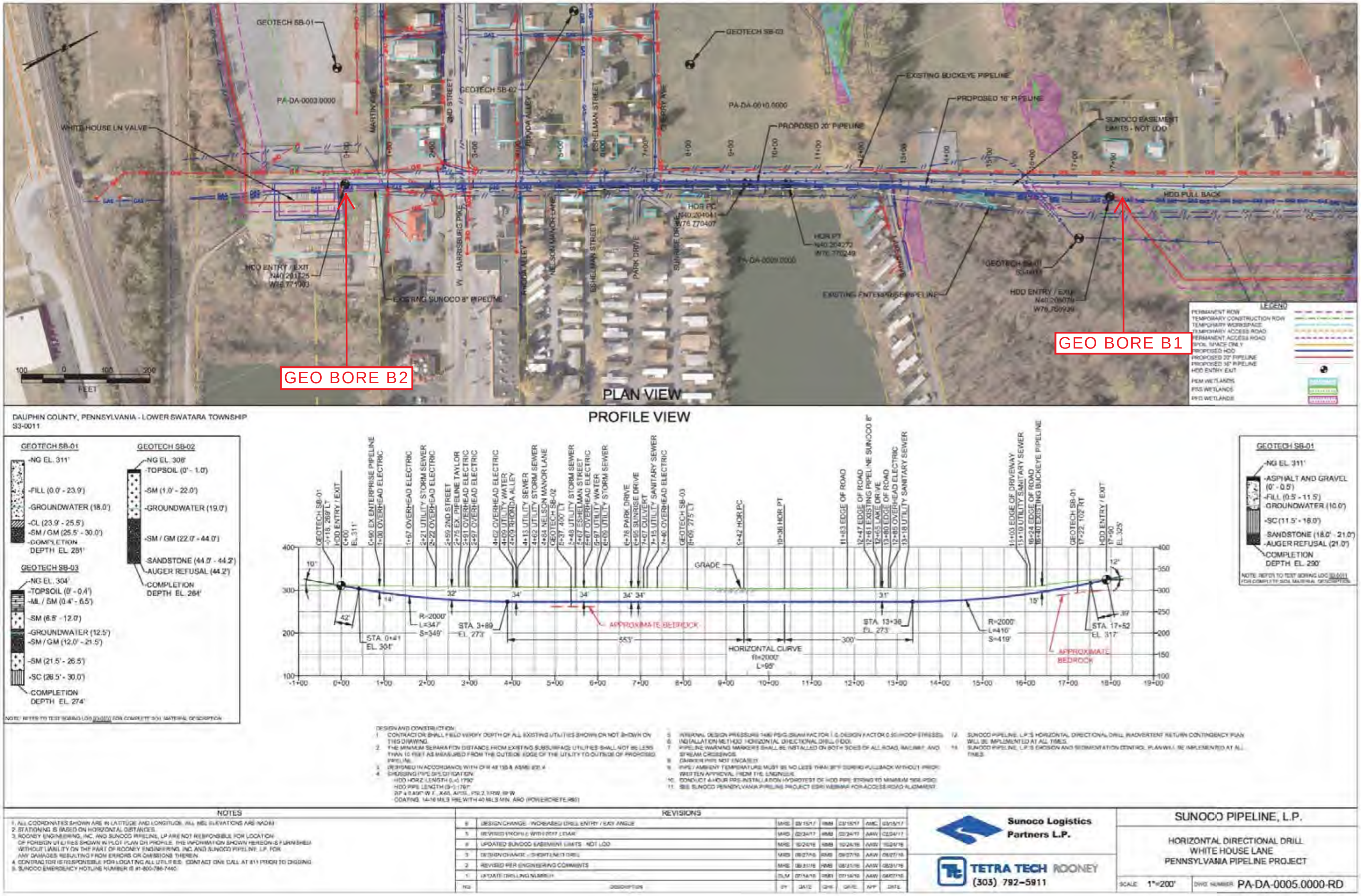

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FIGURE 3: Site Geology Map

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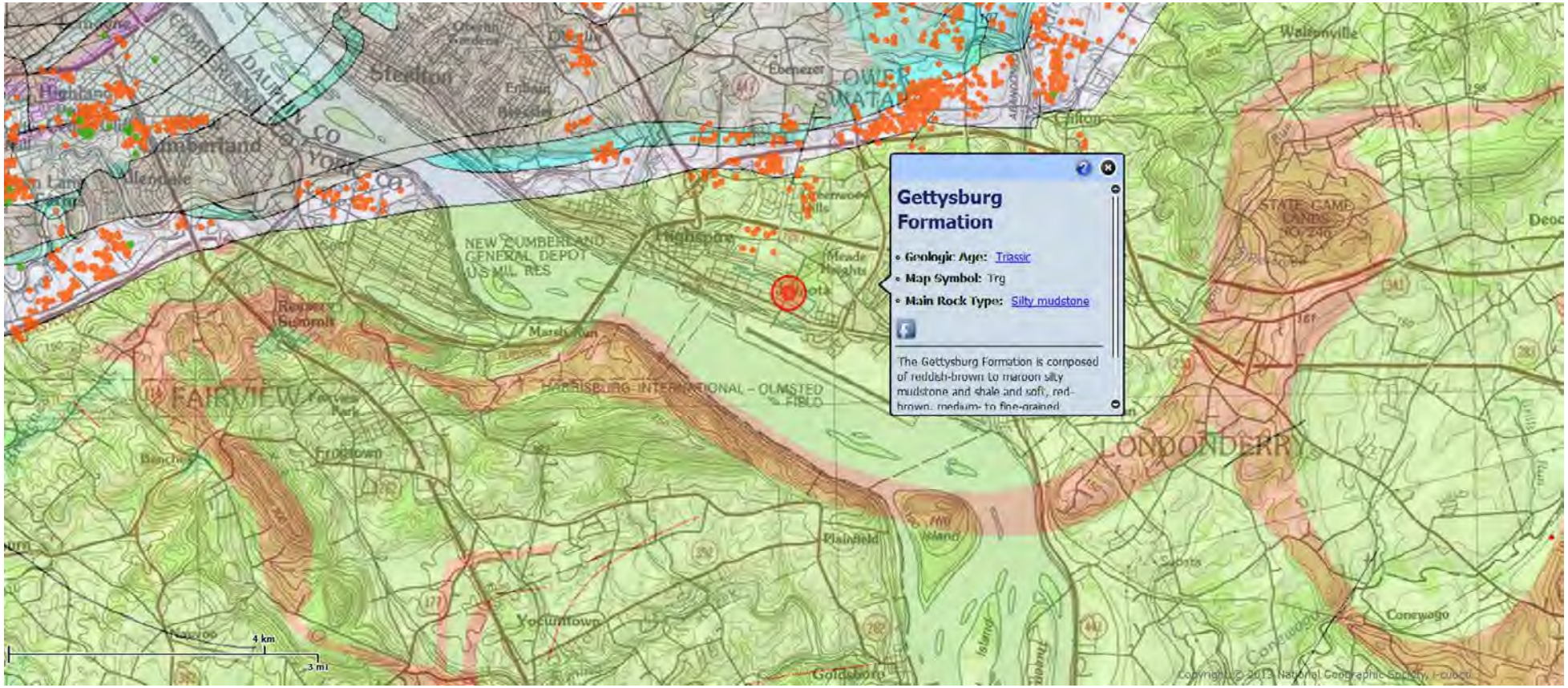

Created using PA DCNR Map Viewer

Map created on Fri Sep 1 2017

BORING B-01

DATE STARTED:	8/10/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/11/17	**DRILLER:** R. Miller	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	SS
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	F. Hoffman

Water — Pre-Core: Dry; Post-Core: 91 feet

BORING LOCATION: See Boring Location Plan

REMARKS:

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					5 inches topsoil					
				S-1	24	**ALLUVIUM**-Very Soft, Light brown, SILT with Sand, moist	ML	1-1-1-1 N=2			
				S-2	16	**ALLUVIUM**-Medium Stiff, Light brown, SILT with Sand, moist	ML	2-3-2-1 N=5			
	5			S-3	24	**ALLUVIUM**-Medium Dense, Light brown, Silty SAND, moist	SM	4-6-7-6 N=13			
				S-4	12	**ALLUVIUM**-Loose, Light gray, Poorly Graded SAND, trace Silt, moist	SP	4-3-2-4 N=5			
				S-5	24	**ALLUVIUM**-Medium Dense, Light gray/light brown, Poorly Graded SAND, trace shale fragments, moist	SP	8-12-11-13 N=23			
	10										
						ALLUVIUM-Medium Dense, Gray to light brown to red-brown, Poorly Graded GRAVEL with Sand, wet					
	15			S-6	13		GP	12-14-15-16 N=29			
	20			S-7	4			13-10-9-12 N=19			
	25			R-1	6	~~Conglomeratic SANDSTONE~~- Red-gray-brown, Fine to very coarse grained, Highly Weathered to Completely Weathered, very broken to broken, moderately hard		RQD=0 Rec=28%			4 min. >>◎
				R-2	36	~~Conglomeratic SANDSTONE~~- Red-gray-brown, Fine to very coarse grained, Weathered, broken to slightly broken, moderately hard		RQD=28 Rec=100%			2 min. 3 min. 2 min.
	30					*Continued Next Page*					

Professional Service Industries, Inc.
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Harrisburg, PA 17104
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PROJECT NO.: 04911450
PROJECT: Energy Transfer HDD (DPS)
LOCATION: White House Lane (PPP4) Dauphin Co., PA
~~PA-DA-0005.0000-RD/PO#20170804-5~~

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

BORING B-01

DATE STARTED:	8/10/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/11/17	**DRILLER:** R. Miller	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	SS
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	F. Hoffman

Water — Pre-Core: Dry; Post-Core: 91 feet

BORING LOCATION: See Boring Location Plan

REMARKS:

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
	30					**Conglomeratic SANDSTONE**- Red-gray-brown, Fine to very coarse grained, Weathered to Slightly Weathered, broken to massive, hard to very hard					2 min.
											2 min.
											2 min.
				R-3	58			RQD=58 Rec=97%			2 min.
											2 min.
	35					**Conglomeratic SANDSTONE**- Red-gray-brown, Fine to very coarse grained, Slightly Weathered, broken to massive, hard					3 min.
											2 min.
											2 min.
				R-4	60			RQD=78 Rec=100%			1 min.
											2 min.
	40										2 min.
											2 min.
											1 min.
				R-5	46			RQD=58 Rec=76%			2 min.
						Conglomeratic SANDSTONE- Red-gray-brown, Fine to very coarse grained, Weathered to Highly Weathered, very broken to slightly broken, hard Sand/Gravel seam, possible washout @ 44.2 feet					2 min.
	45										2 min.
											3 min.
						Conglomeratic SANDSTONE- Red-gray-brown, Fine to very coarse grained, Weathered to Slightly Weathered, very broken to massive, hard					2 min.
				R-6	60			RQD=65 Rec=100%			2 min.
						SILTSTONE-Red-gray-brown, Very fine grained, Slightly Weathered, very broken to massive, moderately hard Weathered layer @ 50 feet (~ 5 inches thick)					2 min.
	50										3 min.
											3 min.
											2 min.
				R-7	60			RQD=81 Rec=100%			2 min.
											2 min.
						Conglomeratic SANDSTONE- Red-gray-brown, Fine to coarse grained, Slightly Weathered, broken to massive, moderately hard to hard					2 min.
	55										2 min.
						SILTSTONE-Red-gray-brown, Very fine grained, Slightly Weathered, very broken to massive, moderately hard to hard					2 min.
											3 min.
				R-8	59			RQD=82 Rec=98%			2 min.
						Very broken seam @ 58.5 feet (~ 1-3/4 inches thick)					2 min.
	60										

Continued Next Page

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BORING B-01

DATE STARTED:	8/10/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/11/17	**DRILLER:** R. Miller	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	SS
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	F. Hoffman

Water — Pre-Core: Dry; Post-Core: 91 feet

BORING LOCATION: See Boring Location Plan

REMARKS:

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			R-9	60	**SILTSTONE**-Red-gray-brown, Very fine grained, Slightly Weathered, very broken to massive, moderately hard to hard		RQD=41 Rec=100%			3 min. 2 min. 2 min. 2 min. 2 min.
	65			R-10	59	**Conglomeratic SANDSTONE**-Red-gray-brown, Fine to very coarse grained, Weathered to Slightly Weathered, very broken to massive, moderately hard to very hard		RQD=41 Rec=98%			2 min. 2 min. 2 min. 2 min. 3 min.
	70			R-11	60	**SILTSTONE**-Red-gray-brown, Very fine grained, Slightly Weathered, broken to massive, moderately hard Completely Weathered seam @ 72.1 feet (~ 1-3/4 inches thick) Very broken seam @ 73.7 feet (~ 3/4 inch thick)		RQD=83 Rec=100%			3 min. 3 min. 3 min. 3 min. 2 min.
	75			R-12	60	**SANDSTONE**-Red-gray-brown, Fine grained, Slightly Weathered, slightly broken to massive, moderately hard Completely Weathered seam @ 79.4 feet (~ 2-1/2 inches thick)		RQD=95 Rec=100%			3 min. 2 min. 2 min. 2 min. 2 min.
	80			R-13	60	**SANDSTONE**-Red-gray-brown, Fine grained, Weathered to Slightly Weathered, very broken to massive, moderately hard to hard **SANDSTONE**-Red-gray-brown, Fine grained, Slightly Weathered, very broken to massive, moderately hard to hard		RQD=71 Rec=100%			3 min. 3 min. 3 min. 3 min. 3 min.
	85			R-14	60	Weathered/Highly Weathered layer @ 87.8 feet (~ 7-3/4 inches thick) Lost water @ 88 feet		RQD=76 Rec=99%			3 min. 4 min. 3 min. 2 min. 3 min.
	90										

Continued Next Page

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PROJECT NO.: 04911450
PROJECT: Energy Transfer HDD (DPS)
LOCATION: White House Lane (PPP4) Dauphin Co., PA
PA-DA-0005.0000-RD/PO#20170804-5

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

BORING B-01

DATE STARTED:	8/10/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/11/17	**DRILLER:** R. Miller	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	SS
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	F. Hoffman

REMARKS:

Water
- Pre-Core: Dry
- Post-Core: 91 feet

BORING LOCATION:
See 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					**SANDSTONE**-Red-gray-brown, Fine grained, Slightly Weathered, very broken to massive, moderately hard to hard					3 min.
											2 min.
				R-15	58			RQD=88 Rec=97%			3 min.
											2 min.
						Weathered layer @ 93.4 feet (~ 4-1/4 inches thick)					2 min.
	95										2 min.
											3 min.
				R-16	60			RQD=88 Rec=99%			2 min.
											2 min.
											2 min.
	100					**SILTSTONE**-Red-gray-brown, Very fine grained, Weathered to Slightly Weathered, very broken to broken, moderately hard					2 min.
						Test boring terminated @ 100 feet					

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LOCATION: White House Lane (PPP4) Dauphin Co., PA
PA-DA-0005.0000-RD/PO#20170804-5

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


0491-1450
White House Ln.
PPP4
B-1
Box 1 of –
8/11/17
Run | Depth | Rec. | RQD
R-1 | 25.2-27.0 | 0.5 | 0.0
R-2 | 27.0-30.0 | 3.0 | 0.8
R-3 | 30.0-35.0 | 4.8 | 2.9
R-4 | 35.0-40.0 | 5.0 | 3.9
TOP
25.2
27.0
30.0
35.0
40.0
THIS SIDE UP
HANDLE WITH CARE


0491-1450
White House Ln.
PPP4
B-1
Box 2 of _
8/11/17
Run | Depth | Rec | RQD
R-5 | 40.0 - 45.0 | 3.8 | 3.1
R-6 | 45.0 - 50.0 | 4.9 | 3.6
R-7 | 50.0 - 55.0 | 5.0 | 4.0
TOP
40.0
45.0
50.0
55.0


0491-1450
White House Ln.
PPP4
B-1
Box 3 of _
8/11/17
Run | Depth | Rec. | RQD
R-8 | 55.0-60.0 | 4.9 | 3.5
R-9 | 60.0-65.0 | 5.0 | 2.5
R-10 | 65.0-70.0 | 4.9 | 2.2
TOP
55.0
60.0
65.0
70.0
8/11/17


1491-1450
White House Ln.
PDP4
B-1
Box 4 of —
Run | Depth | Rec. | RQD
R-11 | 70.0-75.0 | 5.0 | 4.4
R-12 | 75.0-80.0 | 5.0 | 4.8
R-13 | 80.0-85.0 | 5.0 | 3.6
Top
70.0
75.0
80.0
85.0


0491-1450
White Haven Ln.
PPP4
B-1
Box 5 of 5
8/11/17
Run | Depth | Rec. | RQD
R-14 | 85.0-90.0 | 5.0 | 4.3
R-15 | 90.0-95.0 | 4.8 | 4.4
R-16 | 95.0-100.0 | 5.0 | 4.5
EOB
TOP
85.0
90.0
95.0
100.0
8/11/17

BORING B-02

DATE STARTED:	8/17/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/18/17	**DRILLER:** R. Miller	**LOGGED BY:** F. Hoffman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS1.874-in Core
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	P. McMichael

Water: While Drilling 15 feet

BORING LOCATION: See Boring Location Plan

REMARKS:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS) RQD & Recovery % (NX)	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		**FILL**-Loose, Gray-brown to dark gray-brown, Silty SAND, trace Gravel, moist	SM	5-5-3-3 N=8			
				S-2		**FILL**-Soft, Gray-brown, Sandy SILT, moist	ML	3-2-2-1 N=4			
	5			S-3		**FILL**-Gray-brown, Silty SAND with Gravel, moist/wet	SM	8-12-12-12 N=24			
				S-4				9-7-9-22 N=16			
				S-5		**Probable FILL**-Gray-brown, Poorly Graded GRAVEL with Silt and Sand, dry/moist	GP-GM	13-22-19-17 N=41			
	10										
	15			S-6		**Probable ALLUVIUM**-Medium Dense, Dark gray-brown, Poorly Graded GRAVEL with Sand, trace Silt, wet	GP	11-12-15-16 N=27			
	20			S-7		**ALLUVIUM**-Dense, Gray-brown, Silty GRAVEL with Sand, wet	GM	12-18-19-20 N=37			
	25			S-8		**ALLUVIUM**-Very Dense, Dark gray-brown, Silty SAND with Gravel and cobbles*, wet *Auger refusal was encountered several times between 25 and 32 feet and rock coring attempts were made; however, in each instance, the drillers broke back into soil after only a few inches of coring. The materials recovered from these short coring attempts generally consisted of rounded gravel- and cobble-sized fragments.	SM GC	18-50/5"		>>◎	
	30										

Continued Next Page

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PROJECT NO.: 04911450
PROJECT: Energy Transfer HDD (DPS)
LOCATION: White House Lane (PPP4) Dauphin Co., PA
PA-DA-0005.0000-RD/PO#20170804-5

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

BORING B-02

DATE STARTED:	8/17/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/18/17	**DRILLER:** R. Miller	**LOGGED BY:** F. Hoffman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS1.874-in Core
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	P. McMichael

Water ▽ While Drilling 15 feet

BORING LOCATION: See Boring Location Plan

REMARKS:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS) RQD & Recovery % (NX)	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
	30			S-9		**ALLUVIUM**-Very Dense, Gray-brown to red-brown, Clayey GRAVEL with Sand and cobbles, moist/wet	GC	18-36-50/4"		>>◎	
				R-1	20	**Conglomeratic SANDSTONE**-Red-brown to gray-brown, Fine to coarse grained, Weathered to Highly Weathered, broken to slightly broken, moderately hard		RQD=0 Rec=42%			
	35			R-2	13			RQD=0 Rec=26%			
	40			R-3	60	**SANDSTONE**-Brown to gray-brown, Fine grained, Weathered to Slightly Weathered, very broken to massive, moderately hard to hard		RQD=43 Rec=100%			
	45			R-4	60	**SILTSTONE**-Gray-brown to dark brown, Very fine grained, Weathered to Slightly Weathered, very broken to massive, moderately hard Very broken seam @ 46.3 feet (~ 1-1/4 inches thick) **SANDSTONE**-Red-gray-brown to gray-brown, Fine to medium grained, Weathered to Slightly Weathered, very broken to massive, moderately hard to hard		RQD=65 Rec=100%			
	50			R-5	59	**Conglomeratic SANDSTONE**-Dark brown, Fine to coarse grained, Slightly Weathered, broken to massive, moderately hard to hard Weathered layer @ 51.3 feet (~ 11-1/2 inches thick)		RQD=63 Rec=98%			
	55			R-6	60	Weathered seam with soil parting @ 54.5 feet (~ 3/4 inch thick) **SANDSTONE**-Red-gray-brown to gray-brown, Fine grained, Slightly Weathered, slightly broken to massive, moderately hard **SILTSTONE**-Gray-brown, Very fine grained, Slightly Weathered, broken to massive, moderately hard		RQD=87 Rec=99%			
	60					*Continued Next Page*					

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PROJECT NO.: 04911450
PROJECT: Energy Transfer HDD (DPS)
LOCATION: White House Lane (PPP4) Dauphin Co., PA
PA-DA-0005.0000-RD/PO#20170804-5

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

BORING B-02

DATE STARTED:	8/17/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/18/17	**DRILLER:** R. Miller	**LOGGED BY:** F. Hoffman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS1.874-in Core
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	P. McMichael

Water While Drilling 15 feet

BORING LOCATION:
See Boring Location Plan

REMARKS:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS) RQD & Recovery % (NX)	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					**SANDSTONE**-Red-gray-brown, Fine grained, Slightly Weathered, slightly broken to massive, moderately hard					
				R-7	60	**SILTSTONE**-Red-gray-brown, Very fine grained, Slightly Weathered, very broken to massive, moderately hard		RQD=100 Rec=100%			
	65										
				R-8	60	**SANDSTONE**-Red-gray-brown to dark gray-brown, Fine to coarse grained, Slightly Weathered, very broken to massive, moderately hard to hard		RQD=89 Rec=100%			
	70										
				R-9	60			RQD=94 Rec=100%			
	75					Weathered/Highly Weathered shale seam @ 75.5 feet (~ 1-1/2 inches thick)					
				R-10	60			RQD=73 Rec=99%			
	80					Broken/very broken seam @ 80.4 feet (~ 2 inches thick)					
				R-11	60	**SILTSTONE**-Red-gray-brown to gray-brown, Very fine grained, Slightly Weathered, massive, moderately hard		RQD=88 Rec=100%			
	85					Very broken seam @ 85 feet (~ 1/2 inch thick)					
				R-12	60	**SANDSTONE**-Red-gray-brown to dark gray-brown, Fine grained, Slightly Weathered, massive, moderately hard to hard		RQD=96 Rec=100%			
	90										

Continued Next Page

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PROJECT NO.: 04911450
PROJECT: Energy Transfer HDD (DPS)
LOCATION: White House Lane (PPP4) Dauphin Co., PA
PA-DA-0005.0000-RD/PO#20170804-5

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

BORING B-02

DATE STARTED:	8/17/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/18/17	**DRILLER:** R. Miller	**LOGGED BY:** F. Hoffman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS1.874-in Core
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	P. McMichael

Water ▽ While Drilling 15 feet

BORING LOCATION: See Boring Location Plan

REMARKS:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS) RQD & Recovery % (NX)	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					**SANDSTONE**-Red-gray-brown to dark gray-brown, Fine grained, Slightly Weathered, massive, moderately hard to hard					
				R-13	60	**SILTSTONE**-Red-gray-brown to light red-gray-brown, Very fine grained, Slightly Weathered, broken to massive, moderately hard to hard		RQD=95 Rec=100%			
	95					Broken seam @ 95 feet (~ 1/2 inch thick)					
				R-14	60	**SANDSTONE**-Light gray-brown to gray-brown, Fine to medium grained, Slightly Weathered, broken to massive, hard		RQD=83 Rec=100%			
	100					Test boring terminated @ 100 feet					

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PROJECT NO.: 04911450
PROJECT: Energy Transfer HDD (DPS)
LOCATION: White House Lane (PPP4) Dauphin Co., PA
PA-DA-0005.0000-RD/PO#20170804-5

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


Box #1 of 5
8/17/17
B-#2
100 White House Cave (
Lower Swatara Twp.
Run #
Depth (ft)
Rec (in)
RQD (in)
R#1
32.0 - 36.0
25"
0"
R#1
36.0 -
12.5"
0"
R#2
40.0 - 45.0
66"
25.5"
R#3
45.0 - 50.0
46"
39"
R#4
32'
40.0
45.0


0491450
Box 2 of 5
8/17/17
B-[redacted]2
100 White House Lane (nearest intersec. Stanton Ave)
Lower Swatara Twp.
Run # | Depth | Rec | RQD
R[redacted]5 | 50.0 - 55.0 | [redacted]59" | [redacted]36"
R[redacted]6 | 55.0 - 60.0 | [redacted]59.5" | [redacted]52"
R[redacted]7 | 60.0 - 65.0 | [redacted]40" | [redacted]40"
50.0
55.0
60.0
65.0


0491450
Box 3 of 5
8/17/17 - 8/18/17
B-[redacted]2
100 White House Lane (Nearest intersec. Martin Ave)
Lower Swatara Twp.
Run
Depth
Rec
RQD
8/17/17 R[redacted]8 65.0-70.0 60" 53.5"
8/17/17 R[redacted]9 70.0-75.0 60" 56.5"
8/18/17 R[redacted]10 75.0-80.0 59.5" 44"
65.0
70.0
75.0
80.0


p4911450
Box 4 of 5
5/18/17
100 Cohrte Horse Lane
Lower Swatara Twp.
B-2 (80-95')
Run
Depth
Rec.
RQD
R 11
80.0 - 85.0
60"
52.5"
R 12
85.0 - 90.0
60"
57.5"
R 13
90.0 - 95.0
60"
57"
80.0
85.0
90.0


BOX 5 OF 5
DATE:
B-12
95.0'
FT TO 100.0 FT
8/14/17
100 WHITE HOUSE LANE (second house North Ave)
Lower Swatara Twp
COUNTY
SEGMENT
OFF.
RUN NO. 5
DEPTH
RECOVERY
RQD
R14
95.0 - 100.0
60"
50"

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GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger

SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
RC: Rock Core
TC: Texas Cone
BS: Bulk Sample
PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N_{60}: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼,▽,⧩ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

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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

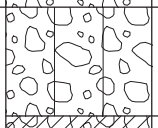
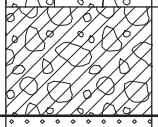
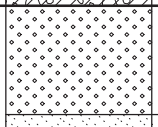
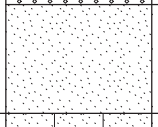
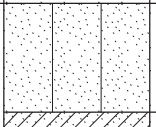
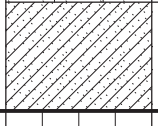
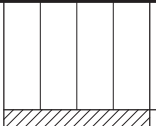
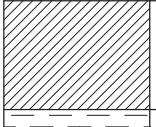
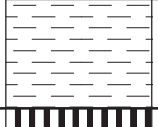
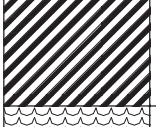
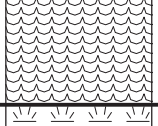
MAJOR DIVISIONS			SYMBOLS: GRAPH	SYMBOLS: LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - 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.

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FIGURE 1: Site Vicinity Map

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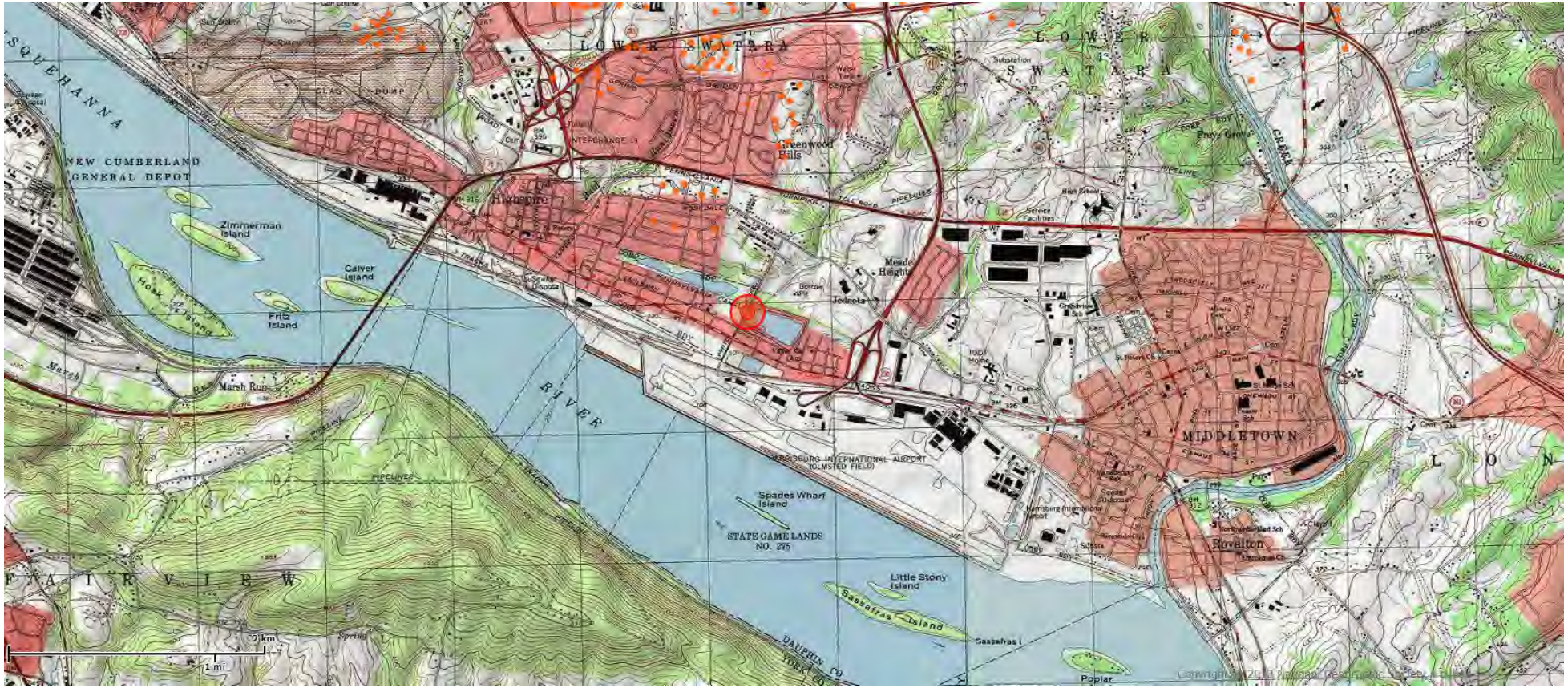


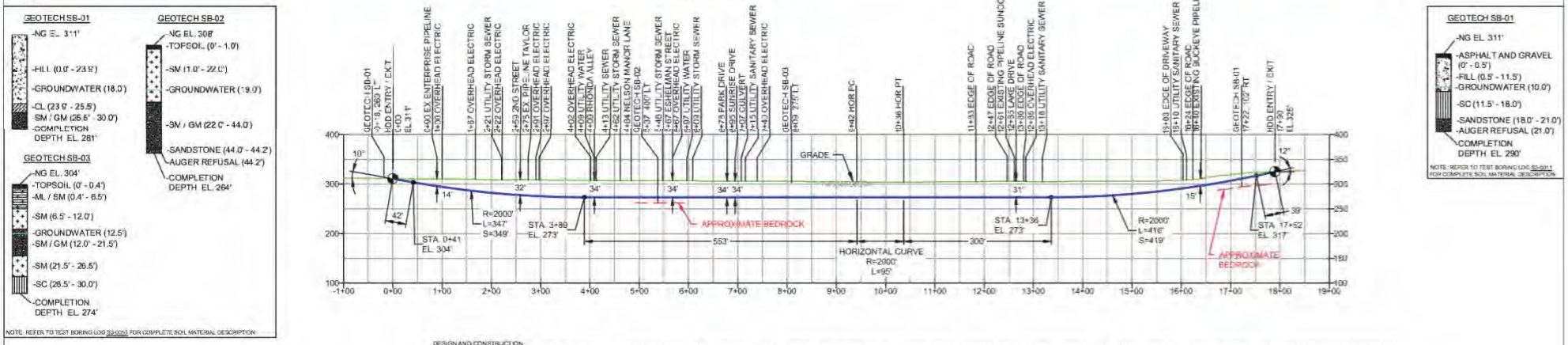
Created using PA DCNR Map Viewer

Map created on Fri Sep 1 2017

FIGURE 2: Boring Location Plan
White House Lane - PPP4
DPS PO# 20170804-5
PSI Proj # 04911450

DAUPHIN COUNTY, PENNSYLVANIA - LOWER SWATARA TOWNSHIP
S3-0011

PROFILE VIEW



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+1)=1790'
HDD PIPE LENGTH (3+)=1797'
20" X 0.456" W.T., X-65, API 5L, PSL2, ERW, SFW
COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R65)
5. INTERNAL DESIGN PRESSURE: 1480 PSIG (BEAM 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.
12. SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
13. SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

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
6	DESIGN CHANGE - INCREASED DRILL ENTRY / EXIT ANGLE	MRS	05/15/17	RMB	05/15/17	AMC	05/15/17
5	REVISED PROFILE WITH 2017 LIDAR	MRS	02/24/17	RMB	02/24/17	AAW	02/24/17
4	UPDATED SUNOCO EASEMENT LIMITS - NOT LOD	MRS	10/26/16	RMB	10/26/16	AAW	10/26/16
3	DESIGN CHANGE - SHORTENED DRILL	MRS	09/27/16	RMB	09/27/16	AAW	09/27/16
2	REVISED PER ENGINEERING COMMENTS	MRS	08/31/16	RMB	08/31/16	AAW	08/31/16
1	UPDATE DRILLING NUMBER	CLM	07/14/16	RMB	07/14/16	AAW	07/27/16

Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
WHITE HOUSE LANE
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200' DWG. NUMBER: PA-DA-0005.0000-RD

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FIGURE 3: Site Geology Map

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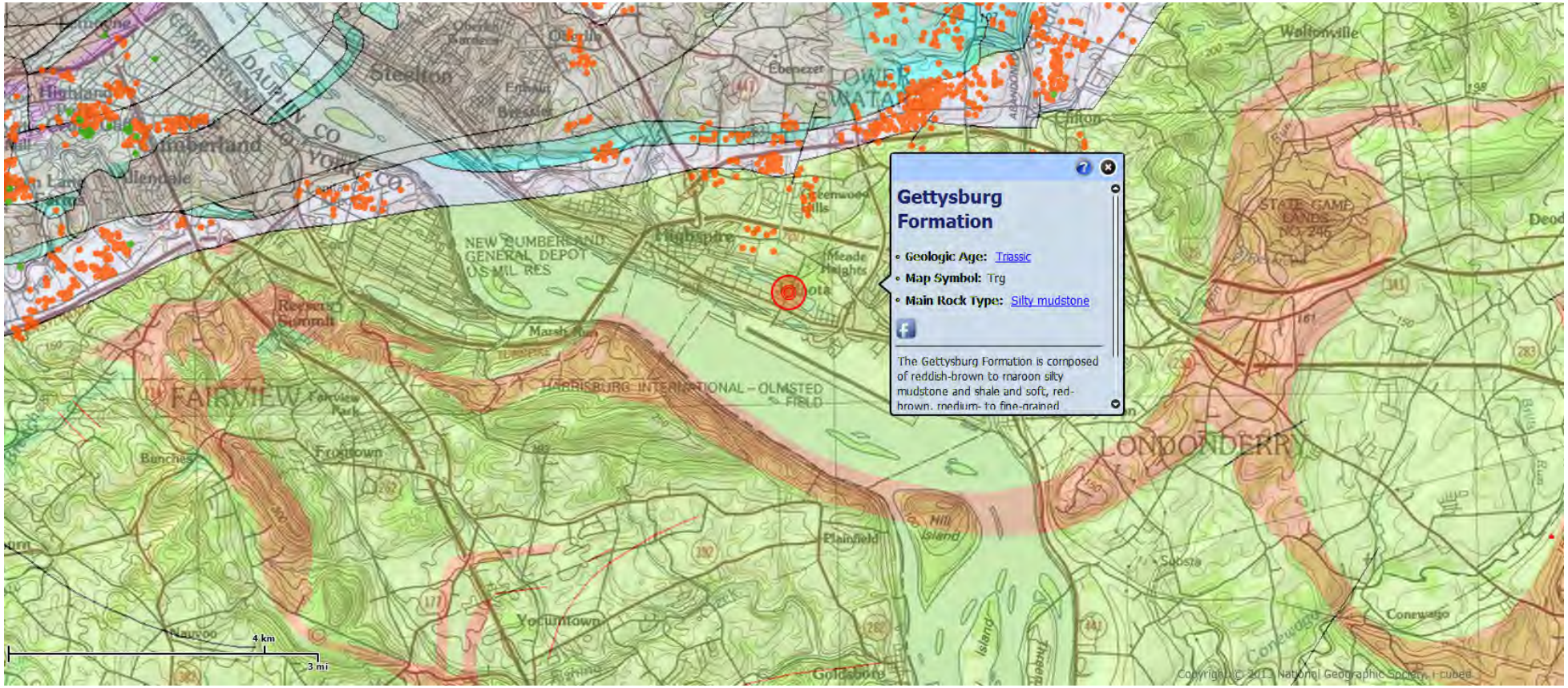

Created using PA DCNR Map Viewer

Map created on Fri Sep 1 2017

BORING B-01

DATE STARTED:	8/10/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/11/17	**DRILLER:** R. Miller	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	SS
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	F. Hoffman

Water — Pre-Core: Dry; Post-Core: 91 feet

BORING LOCATION: See Boring Location Plan

REMARKS:

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					5 inches topsoil					
				S-1	24	**ALLUVIUM**-Very Soft, Light brown, SILT with Sand, moist	ML	1-1-1-1 N=2			
				S-2	16	**ALLUVIUM**-Medium Stiff, Light brown, SILT with Sand, moist	ML	2-3-2-1 N=5			
	5			S-3	24	**ALLUVIUM**-Medium Dense, Light brown, Silty SAND, moist	SM	4-6-7-6 N=13			
				S-4	12	**ALLUVIUM**-Loose, Light gray, Poorly Graded SAND, trace Silt, moist	SP	4-3-2-4 N=5			
				S-5	24	**ALLUVIUM**-Medium Dense, Light gray/light brown, Poorly Graded SAND, trace shale fragments, moist	SP	8-12-11-13 N=23			
	10										
						ALLUVIUM-Medium Dense, Gray to light brown to red-brown, Poorly Graded GRAVEL with Sand, wet					
	15			S-6	13		GP	12-14-15-16 N=29			
	20			S-7	4			13-10-9-12 N=19			
	25			R-1	6	~~Conglomeratic SANDSTONE~~- Red-gray-brown, Fine to very coarse grained, Highly Weathered to Completely Weathered, very broken to broken, moderately hard		RQD=0 Rec=28%			4 min. >> 2 min.
				R-2	36	~~Conglomeratic SANDSTONE~~- Red-gray-brown, Fine to very coarse grained, Weathered, broken to slightly broken, moderately hard		RQD=28 Rec=100%			3 min. 2 min.
	30					*Continued Next Page*					

Professional Service Industries, Inc.
1707 S. Cameron Street, Suite B
Harrisburg, PA 17104
Telephone: (717) 230-8622

PROJECT NO.: 04911450
PROJECT: Energy Transfer HDD (DPS)
LOCATION: White House Lane (PPP4) Dauphin Co., PA
~~PA-DA-0005.0000-RD/PO#20170804-5~~

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

BORING B-01

DATE STARTED:	8/10/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/11/17	**DRILLER:** R. Miller	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	SS
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	F. Hoffman

Water — Pre-Core: Dry; Post-Core: 91 feet

BORING LOCATION: See Boring Location Plan

REMARKS:

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
	30					**Conglomeratic SANDSTONE**- Red-gray-brown, Fine to very coarse grained, Weathered to Slightly Weathered, broken to massive, hard to very hard					2 min.
											2 min.
											2 min.
				R-3	58			RQD=58 Rec=97%			2 min.
											2 min.
	35					**Conglomeratic SANDSTONE**- Red-gray-brown, Fine to very coarse grained, Slightly Weathered, broken to massive, hard					3 min.
											2 min.
											2 min.
				R-4	60			RQD=78 Rec=100%			1 min.
											2 min.
	40										2 min.
											2 min.
											1 min.
				R-5	46			RQD=58 Rec=76%			2 min.
						Conglomeratic SANDSTONE- Red-gray-brown, Fine to very coarse grained, Weathered to Highly Weathered, very broken to slightly broken, hard Sand/Gravel seam, possible washout @ 44.2 feet					2 min.
	45										2 min.
						Conglomeratic SANDSTONE- Red-gray-brown, Fine to very coarse grained, Weathered to Slightly Weathered, very broken to massive, hard					3 min.
				R-6	60			RQD=65 Rec=100%			2 min.
						SILTSTONE-Red-gray-brown, Very fine grained, Slightly Weathered, very broken to massive, moderately hard Weathered layer @ 50 feet (~ 5 inches thick)					2 min.
	50										3 min.
											3 min.
											2 min.
				R-7	60			RQD=81 Rec=100%			2 min.
											2 min.
						Conglomeratic SANDSTONE- Red-gray-brown, Fine to coarse grained, Slightly Weathered, broken to massive, moderately hard to hard					2 min.
	55										2 min.
						SILTSTONE-Red-gray-brown, Very fine grained, Slightly Weathered, very broken to massive, moderately hard to hard					2 min.
											3 min.
				R-8	59			RQD=82 Rec=98%			2 min.
						Very broken seam @ 58.5 feet (~ 1-3/4 inches thick)					2 min.
	60										

Continued Next Page

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Professional Service Industries, Inc.
1707 S. Cameron Street, Suite B
Harrisburg, PA 17104
Telephone: (717) 230-8622

PROJECT NO.: 04911450
PROJECT: Energy Transfer HDD (DPS)
LOCATION: White House Lane (PPP4) Dauphin Co., PA
PA-DA-0005.0000-RD/PO#20170804-5

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

DATE STARTED:	8/10/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/11/17	**DRILLER:** R. Miller	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	SS
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	F. Hoffman

REMARKS:

BORING B-01

Water
Pre-Core: Dry
Post-Core: 91 feet

BORING LOCATION:
See 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					**SILTSTONE**-Red-gray-brown, Very fine grained, Slightly Weathered, very broken to massive, moderately hard to hard					3 min.
											2 min.
				R-9	60			RQD=41 Rec=100%			2 min.
											2 min.
											2 min.
	65					**Conglomeratic SANDSTONE**-Red-gray-brown, Fine to very coarse grained, Weathered to Slightly Weathered, very broken to massive, moderately hard to very hard					2 min.
											2 min.
				R-10	59			RQD=41 Rec=98%			2 min.
											2 min.
						SILTSTONE-Red-gray-brown, Very fine grained, Slightly Weathered, broken to massive, moderately hard					3 min.
	70										3 min.
											3 min.
				R-11	60	Completely Weathered seam @ 72.1 feet (~ 1-3/4 inches thick)		RQD=83 Rec=100%			3 min.
						Very broken seam @ 73.7 feet (~ 3/4 inch thick)					3 min.
											2 min.
	75					**SANDSTONE**-Red-gray-brown, Fine grained, Slightly Weathered, slightly broken to massive, moderately hard					3 min.
											2 min.
				R-12	60			RQD=95 Rec=100%			2 min.
											2 min.
						Completely Weathered seam @ 79.4 feet (~ 2-1/2 inches thick)					2 min.
	80					**SANDSTONE**-Red-gray-brown, Fine grained, Weathered to Slightly Weathered, very broken to massive, moderately hard to hard					3 min.
											3 min.
				R-13	60			RQD=71 Rec=100%			3 min.
						SANDSTONE-Red-gray-brown, Fine grained, Slightly Weathered, very broken to massive, moderately hard to hard					3 min.
											3 min.
	85										3 min.
											4 min.
				R-14	60			RQD=76 Rec=99%			3 min.
						Weathered/Highly Weathered layer @ 87.8 feet (~ 7-3/4 inches thick) Lost water @ 88 feet					2 min.
											3 min.
	90										

Continued Next Page

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PROJECT NO.: 04911450
PROJECT: Energy Transfer HDD (DPS)
LOCATION: White House Lane (PPP4) Dauphin Co., PA
PA-DA-0005.0000-RD/PO#20170804-5

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

BORING B-01

DATE STARTED:	8/10/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/11/17	**DRILLER:** R. Miller	**LOGGED BY:** C. Lehman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	SS
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	F. Hoffman

REMARKS:

Water
- Pre-Core: Dry
- Post-Core: 91 feet

BORING LOCATION:
See 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					**SANDSTONE**-Red-gray-brown, Fine grained, Slightly Weathered, very broken to massive, moderately hard to hard					3 min.
											2 min.
				R-15	58			RQD=88 Rec=97%			3 min.
											2 min.
						Weathered layer @ 93.4 feet (~ 4-1/4 inches thick)					2 min.
	95										2 min.
											3 min.
				R-16	60			RQD=88 Rec=99%			2 min.
											2 min.
											2 min.
	100					**SILTSTONE**-Red-gray-brown, Very fine grained, Weathered to Slightly Weathered, very broken to broken, moderately hard					2 min.
						Test boring terminated @ 100 feet					

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Harrisburg, PA 17104
Telephone: (717) 230-8622

PROJECT NO.: 04911450
PROJECT: Energy Transfer HDD (DPS)
LOCATION: White House Lane (PPP4)
Dauphin Co., PA
PA-DA-0005.0000-RD/PO#20170804-5

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


0491-1450
White House Ln.
PPP4
B-1
Box 1 of –
8/11/17
Run | Depth | Rec. | RQD
R-1 | 25.2-27.0 | 0.5 | 0.0
R-2 | 27.0-30.0 | 3.0 | 0.8
R-3 | 30.0-35.0 | 4.8 | 2.9
R-4 | 35.0-40.0 | 5.0 | 3.9
TOP
25.2
27.0
30.0
35.0
40.0
THIS SIDE UP
HANDLE WITH CARE


0491-1450
White House Ln.
PPP4
B-1
Box 2 of _
8/11/17
Run | Depth | Rec | RQD
R-5 | 40.0 - 45.0 | 3.8 | 3.1
R-6 | 45.0 - 50.0 | 4.9 | 3.6
R-7 | 50.0 - 55.0 | 5.0 | 4.0
TOP
40.0
45.0
50.0
55.0


0491-1450
White House Ln.
PPP4
B-1
Box 3 of _
8/11/17
Run | Depth | Rec. | RQD
R-8 | 55.0-60.0 | 4.9 | 3.5
R-9 | 60.0-65.0 | 5.0 | 2.5
R-10 | 65.0-70.0 | 4.9 | 2.2
TOP
55.0
60.0
65.0
70.0
8/11/17


1491-1450
White House Ln.
PDP4
B-1
Box 4 of —
Run | Depth | Rec. | RQD
R-11 | 70.0-75.0 | 5.0 | 4.4
R-12 | 75.0-80.0 | 5.0 | 4.8
R-13 | 80.0-85.0 | 5.0 | 3.6
TOP
70.0
75.0
80.0
85.0


0491-1450
White Haven Ln.
PPP4
B-1
Box 5 of 5
8/11/17
Run | Depth | Rec. | RQD
R-14 | 85.0-90.0 | 5.0 | 4.3
R-15 | 90.0-95.0 | 4.8 | 4.4
R-16 | 95.0-100.0 | 5.0 | 4.5
EOB
TOP
85.0
90.0
95.0
100.0
8/11/17

BORING B-02

DATE STARTED:	8/17/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/18/17	**DRILLER:** R. Miller	**LOGGED BY:** F. Hoffman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS1.874-in Core
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	P. McMichael

Water ▽ While Drilling 15 feet

BORING LOCATION: See Boring Location Plan

REMARKS:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS) RQD & Recovery % (NX)	Moisture, %
	0			S-1		**FILL**-Loose, Gray-brown to dark gray-brown, Silty SAND, trace Gravel, moist	SM	5-5-3-3 N=8	
				S-2		**FILL**-Soft, Gray-brown, Sandy SILT, moist	ML	3-2-2-1 N=4	
	5			S-3		**FILL**-Gray-brown, Silty SAND with Gravel, moist/wet	SM	8-12-12-12 N=24	
				S-4				9-7-9-22 N=16	
				S-5		**Probable FILL**-Gray-brown, Poorly Graded GRAVEL with Silt and Sand, dry/moist	GP-GM	13-22-19-17 N=41	
	10								
	15			S-6		**Probable ALLUVIUM**-Medium Dense, Dark gray-brown, Poorly Graded GRAVEL with Sand, trace Silt, wet	GP	11-12-15-16 N=27	
	20			S-7		**ALLUVIUM**-Dense, Gray-brown, Silty GRAVEL with Sand, wet	GM	12-18-19-20 N=37	
	25			S-8		**ALLUVIUM**-Very Dense, Dark gray-brown, Silty SAND with Gravel and cobbles*, wet *Auger refusal was encountered several times between 25 and 32 feet and rock coring attempts were made; however, in each instance, the drillers broke back into soil after only a few inches of coring. The materials recovered from these short coring attempts generally consisted of rounded gravel- and cobble-sized fragments.	SM GC	18-50/5"	
	30								

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

Continued Next Page

Professional Service Industries, Inc.
1707 S. Cameron Street, Suite B
Harrisburg, PA 17104
Telephone: (717) 230-8622

PROJECT NO.: 04911450
PROJECT: Energy Transfer HDD (DPS)
LOCATION: White House Lane (PPP4)
Dauphin Co., PA
PA-DA-0005.0000-RD/PO#20170804-5

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

BORING B-02

DATE STARTED:	8/17/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/18/17	**DRILLER:** R. Miller	**LOGGED BY:** F. Hoffman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS1.874-in Core
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	P. McMichael

Water ▽ While Drilling 15 feet

BORING LOCATION: See Boring Location Plan

REMARKS:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS) RQD & Recovery % (NX)	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
	30			S-9		**ALLUVIUM**-Very Dense, Gray-brown to red-brown, Clayey GRAVEL with Sand and cobbles, moist/wet	GC	18-36-50/4"		>>◎	
				R-1	20	**Conglomeratic SANDSTONE**-Red-brown to gray-brown, Fine to coarse grained, Weathered to Highly Weathered, broken to slightly broken, moderately hard		RQD=0 Rec=42%			
	35			R-2	13			RQD=0 Rec=26%			
	40			R-3	60	**SANDSTONE**-Brown to gray-brown, Fine grained, Weathered to Slightly Weathered, very broken to massive, moderately hard to hard		RQD=43 Rec=100%			
	45			R-4	60	**SILTSTONE**-Gray-brown to dark brown, Very fine grained, Weathered to Slightly Weathered, very broken to massive, moderately hard Very broken seam @ 46.3 feet (~ 1-1/4 inches thick) **SANDSTONE**-Red-gray-brown to gray-brown, Fine to medium grained, Weathered to Slightly Weathered, very broken to massive, moderately hard to hard		RQD=65 Rec=100%			
	50			R-5	59	**Conglomeratic SANDSTONE**-Dark brown, Fine to coarse grained, Slightly Weathered, broken to massive, moderately hard to hard Weathered layer @ 51.3 feet (~ 11-1/2 inches thick)		RQD=63 Rec=98%			
	55			R-6	60	Weathered seam with soil parting @ 54.5 feet (~ 3/4 inch thick) **SANDSTONE**-Red-gray-brown to gray-brown, Fine grained, Slightly Weathered, slightly broken to massive, moderately hard **SILTSTONE**-Gray-brown, Very fine grained, Slightly Weathered, broken to massive, moderately hard		RQD=87 Rec=99%			
	60					*Continued Next Page*					

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LOCATION: White House Lane (PPP4) Dauphin Co., PA
PA-DA-0005.0000-RD/PO#20170804-5

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

BORING B-02

DATE STARTED:	8/17/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/18/17	**DRILLER:** R. Miller	**LOGGED BY:** F. Hoffman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS1.874-in Core
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	P. McMichael

Water While Drilling 15 feet

BORING LOCATION:
See Boring Location Plan

REMARKS:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS) RQD & Recovery % (NX)	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					**SANDSTONE**-Red-gray-brown, Fine grained, Slightly Weathered, slightly broken to massive, moderately hard					
				R-7	60	**SILTSTONE**-Red-gray-brown, Very fine grained, Slightly Weathered, very broken to massive, moderately hard		RQD=100 Rec=100%			
	65										
				R-8	60	**SANDSTONE**-Red-gray-brown to dark gray-brown, Fine to coarse grained, Slightly Weathered, very broken to massive, moderately hard to hard		RQD=89 Rec=100%			
	70										
				R-9	60			RQD=94 Rec=100%			
	75					Weathered/Highly Weathered shale seam @ 75.5 feet (~ 1-1/2 inches thick)					
				R-10	60			RQD=73 Rec=99%			
	80					Broken/very broken seam @ 80.4 feet (~ 2 inches thick)					
				R-11	60	**SILTSTONE**-Red-gray-brown to gray-brown, Very fine grained, Slightly Weathered, massive, moderately hard		RQD=88 Rec=100%			
	85					Very broken seam @ 85 feet (~ 1/2 inch thick)					
				R-12	60	**SANDSTONE**-Red-gray-brown to dark gray-brown, Fine grained, Slightly Weathered, massive, moderately hard to hard		RQD=96 Rec=100%			
	90										

Continued Next Page

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PROJECT NO.: 04911450
PROJECT: Energy Transfer HDD (DPS)
LOCATION: White House Lane (PPP4)
Dauphin Co., PA
PA-DA-0005.0000-RD/PO#20170804-5

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

BORING B-02

DATE STARTED:	8/17/17	**DRILL COMPANY:**	Allied Well Drilling
DATE COMPLETED:	8/18/17	**DRILLER:** R. Miller	**LOGGED BY:** F. Hoffman
COMPLETION DEPTH	100.0 ft	**DRILL RIG:**	Diedrich D-50 Turbo
BENCHMARK:	N/A	**DRILLING METHOD:**	Casing/Rock Coring
ELEVATION:	N/A	**SAMPLING METHOD:**	2-in SS1.874-in Core
LATITUDE:	n/a°	**HAMMER TYPE:**	Automatic
LONGITUDE:	n/a°	**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	P. McMichael

Water While Drilling 15 feet

BORING LOCATION:
See Boring Location Plan

REMARKS:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS) RQD & Recovery % (NX)	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					**SANDSTONE**-Red-gray-brown to dark gray-brown, Fine grained, Slightly Weathered, massive, moderately hard to hard					
				R-13	60	**SILTSTONE**-Red-gray-brown to light red-gray-brown, Very fine grained, Slightly Weathered, broken to massive, moderately hard to hard		RQD=95 Rec=100%			
	95					Broken seam @ 95 feet (~ 1/2 inch thick)					
				R-14	60	**SANDSTONE**-Light gray-brown to gray-brown, Fine to medium grained, Slightly Weathered, broken to massive, hard		RQD=83 Rec=100%			
	100					Test boring terminated @ 100 feet					

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PROJECT: Energy Transfer HDD (DPS)
LOCATION: White House Lane (PPP4)
Dauphin Co., PA
PA-DA-0005.0000-RD/PO#20170804-5

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

0491950

Box #1 of 5

8/17/17

B-12

100 Whitehouse Lane (nearest intersec. - Mountain Rue)

Lower Swatara Twp.

Run #	Depth (ft)	Rec (%)	RQD (in)
~~Run #~~	~~30.0 - 32.0~~		
R#1	32.0 - 36.0	20"	0"
R#2	36.0 - 40.0	12.5"	0"
R#3	40.0 - 45.0	60"	25.5"
R#4	45.0 - 50.0	60"	39"

04911450
Box 2 of 5
8/17/17
B-[redacted]2
100 White House Lane (nearest intersec. Martin Ave)
Lower Swatara Twp.

Run #	Depth	Rec	RQD
R[redacted]5	50.0 – 55.0	[redacted] 59"	[redacted] 38"
R[redacted]6	55.0 – 60.0	[redacted] 59.5"	[redacted] 52"
R[redacted]7	60.0 – 65.0	[redacted] 60"	[redacted] 60"

0491450
Box 3 of 5
8/17/17 - 8/18/17
B-[redacted]2
100 White House Lane (nearest intersec. Martin Ave)
Lower Swatara Twp.

	Run	Depth	Rec	RQD
8/17/17	R[redacted]8	65.0-70.0	[redacted]60"	[redacted]53.5"
8/17/17	R[redacted]9	70.0-75.0	[redacted]60"	[redacted]56.5"
8/18/17	R[redacted]10	75.0-80.0	[redacted]59.5"	[redacted]44"


0491450
Box 4 of 5
8/18/17
100 White House Lane
Lower Swatara Twp.
B-2 (80-95')
Run | Depth | Rec. | RQD
R 11 | 80.0 - 85.0 | 60" | 52.5"
R 12 | 85.0 - 90.0 | 60" | 57.5"
R 13 | 90.0 - 95.0 | 60" | 57"
80.0
85.0
90.0


BOX 5 OF 5
DATE:
BORING NO. B-12 DEPTH 95.0' FT TO 100.0 FT
DIR. 8/18/17 ELEVATION
100 WHITE HOUSE Lane (nearest intersec. Martin Ave)
Lower Swatara Twp.
COUNTY SEGMENT OFF.
RUN NO. DEPTH RECOVERY RQD
R14 95.0 - 100.0 60" 50"
100.0

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger

SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
RC: Rock Core
TC: Texas Cone
BS: Bulk Sample
PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N_{60}: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼,▽,▼ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

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

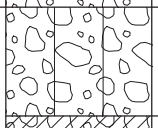
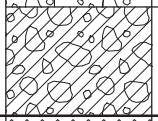
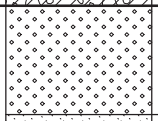
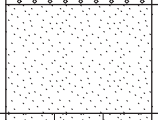
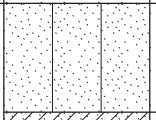
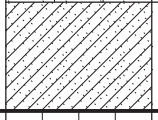
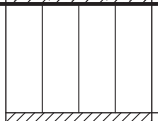
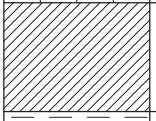
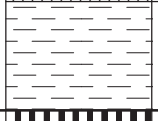
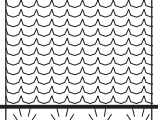
MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND 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

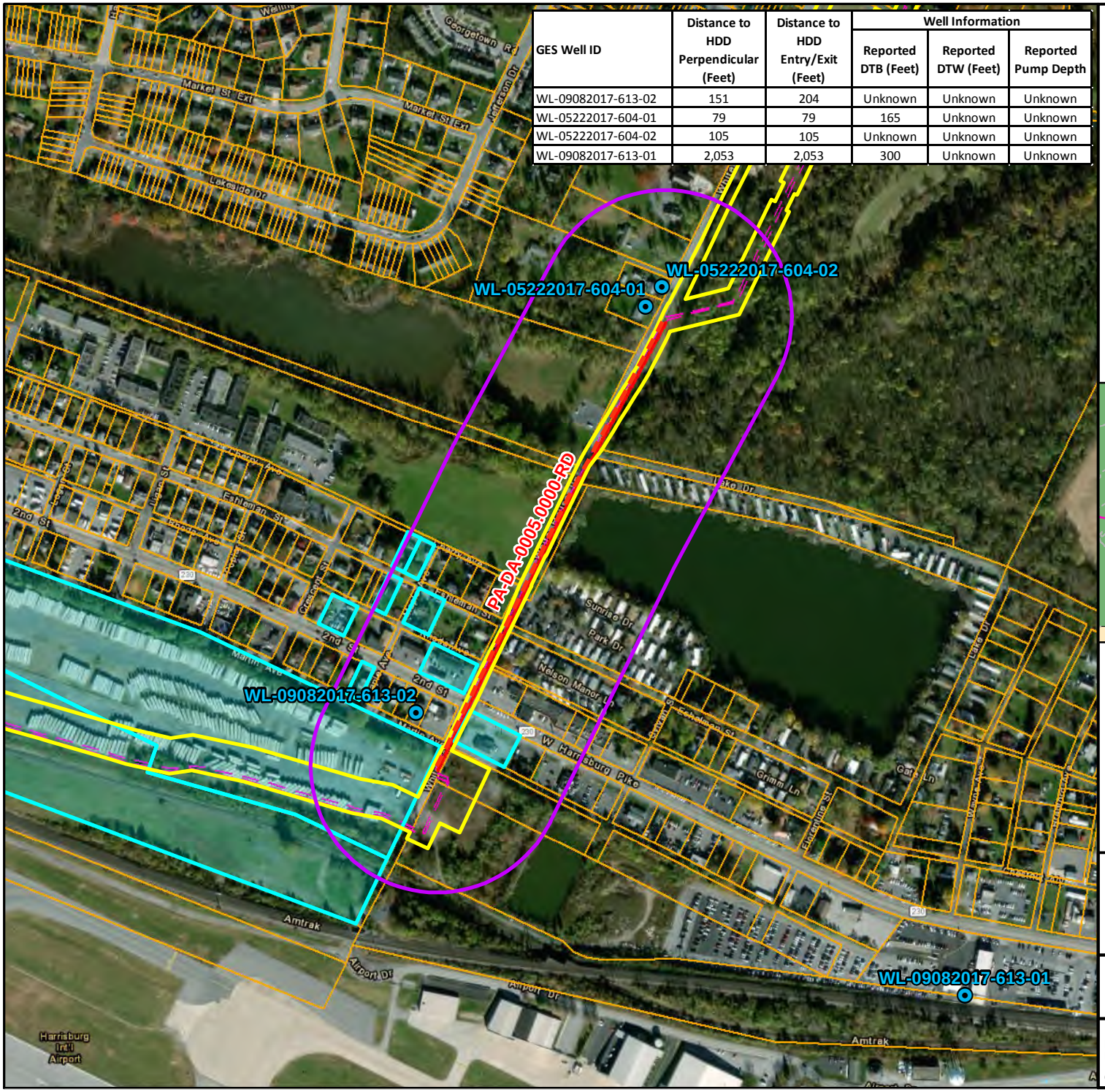
Table 4–3 Hardness and unconfined compressive strength of rock materials

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.

ATTACHMENT 3

GES Well ID	Distance to HDD Perpendicular (Feet)	Distance to HDD Entry/Exit (Feet)	Well Information		
			Reported DTB (Feet)	Reported DTW (Feet)	Reported Pump Depth
WL-09082017-613-02	151	204	Unknown	Unknown	Unknown
WL-05222017-604-01	79	79	165	Unknown	Unknown
WL-05222017-604-02	105	105	Unknown	Unknown	Unknown
WL-09082017-613-01	2,053	2,053	300	Unknown	Unknown



Legend

- LOD
- Parcel
- PPP Centerline
- PPP 1 HDD
- Proposed PPP 2 HDD Redesign
- Public Water Supply/Landowner Confirmed No Well

****Testing locations current as of 02/07/2019**

- GES Testing Location

Location

0 250 500 Feet

Well Location Map
HDD# PA-DA-0005.0000-RD-16
Dauphin County, PA.

Prepared By: TETRA TECH

Date: 2/7/2019

Base Map;
ESRI World Imagery, 09/24/2015

Coordinate System: NAD 83 Stateplane, PA South, Feet

P:\GIS\projects\112C03938-PPP\MXD\WellLocations\WellLocation_PA_DA_0005_0000rd.mxd JL

ATTACHMENT 3
WELLS WITHIN 0.5 MILES OF PROPOSED 16" HDD TRACE - SUNOCO WHITE HOUSE LANE
FROM PAGWIS DATABASE 2-12-19

FID	OBJECTID	PAWellID	County	Municipali	QuadName	WellAddres	WellZipCod	DateDrille	TypeOfActi	LatitudeDD	LongitudeD
0	467	637312	DAUPHIN	HIGHSPIRE BORO	STEELTON	SOUTH 9TH ST. & WRIGHT ST.	17812	2003-12-05	NEW WELL	40.20278	-76.77222
1	468	637313	DAUPHIN	HIGHSPIRE BORO	STEELTON	SOUTH 9TH ST. & WRIGHT ST.	17812	2003-12-05	NEW WELL	40.20278	-76.77222
2	500	636500	DAUPHIN	HIGHSPIRE BORO		686 SECOND STREET	17034	2004-12-03	WELL ABANDONMENT	40.20278	-76.7725
3	501	636499	DAUPHIN	HIGHSPIRE BORO		686 SECOND STREET	17034	2004-12-03	WELL ABANDONMENT	40.20278	-76.7725
4	502	637132	DAUPHIN	HIGHSPIRE BORO		686 SECOND STREET	17034	2004-12-03	WELL ABANDONMENT	40.20278	-76.7725
5	794	548162	DAUPHIN	LOWER SWATARA TWP.	STEELTON	1824 Rosedale Avenue		2014-11-20	NEW WELL	40.21004	-76.76824
6	3422	622632	DAUPHIN	LOWER SWATARA TWP.	STEELTON	AIRPORT DRIVE	17057	2007-08-21	WELL ABANDONMENT	40.21056	-76.77333
7	3614	17578	DAUPHIN	LOWER SWATARA TWP.	STEELTON			1975-08-13		40.2	-76.76611
8	4300	634123	DAUPHIN	HIGHSPIRE BORO		686 MAPLE STREET	17034	2003-07-24	NEW WELL	40.20278	-76.77222
9	4301	634121	DAUPHIN	HIGHSPIRE BORO		686 MAPLE STREET	17034	2003-07-24	NEW WELL	40.20278	-76.77222
10	4577	490440	DAUPHIN	LOWER SWATARA TWP.		78 BRADFORD AVE	17057	2011-07-13	NEW WELL	40.20113	-76.76396
11	4879	560427	DAUPHIN	LONDONDERRY TWP.				1989-07-01	NEW WELL	40.19912	-76.76631
12	4880	560428	DAUPHIN	LONDONDERRY TWP.				1989-07-01	NEW WELL	40.19899	-76.76564
13	4898	560429	DAUPHIN	LONDONDERRY TWP.				1988-07-01	NEW WELL	40.19952	-76.76965
14	7679	561173	DAUPHIN	LOWER SWATARA TWP.	MIDDLETOWN	HBG INTERNATIONAL AIRPORT		1995-03-28	NEW WELL	40.19795	-76.76472
15	7680	561173	DAUPHIN	LOWER SWATARA TWP.	MIDDLETOWN	HBG INTERNATIONAL AIRPORT		1995-03-28	NEW WELL	40.19795	-76.76472
16	7947	631183	DAUPHIN	LOWER SWATARA TWP.		2286 W. HARRISBURG PIKE	17057	2002-03-13	NEW WELL	40.20056	-76.765
17	7948	631183	DAUPHIN	LOWER SWATARA TWP.		2286 W. HARRISBURG PIKE	17057	2002-03-13	NEW WELL	40.20056	-76.765
18	9633	17839	DAUPHIN	LOWER SWATARA TWP.	STEELTON			1934-01-01		40.20056	-76.77444
19	9634	17841	DAUPHIN	LOWER SWATARA TWP.	STEELTON			1934-01-01		40.19778	-76.77389
20	9641	17574	DAUPHIN	LOWER SWATARA TWP.	STEELTON			1934-01-01		40.19944	-76.77722
21	9644	17840	DAUPHIN	LOWER SWATARA TWP.	STEELTON			1934-01-01		40.20056	-76.77444
22	11524	88466	DAUPHIN	LOWER SWATARA TWP.	STEELTON				NEW WELL	40.19889	-76.76833
23	11527	88473	DAUPHIN	LOWER SWATARA TWP.	STEELTON				NEW WELL	40.21111	-76.77056
24	11529	88482	DAUPHIN	LOWER SWATARA TWP.	STEELTON				NEW WELL	40.21056	-76.77

ATTACHMENT 3
WELLS WITHIN 0.5 MILES OF PROPOSED 16" HDD TRACE - SUNOCO WHITE HOUSE LANE
FROM PAGWIS DATABASE 2-12-19

FID	OBJECTID	PAWellID	Driller	OriginalOw	WellUse	WaterUse	WellDepth_	TopOfCasin	BottomOfCa	CasingDiam	DepthToBed	BedrockNot	WellYield_
0	467	637312	EICHELBERGERS INC.	COLUMBIA BULK PLANT	OBSERVATION	UNUSED	60	0	20	4	30	False	0
1	468	637313	EICHELBERGERS INC.	COLUMBIA BULK PLANT	OBSERVATION	UNUSED	60	0	20	4	33	False	0
2	500	636500	EICHELBERGERS INC.	SICO - TURKEY HILL #125	ABANDONED	UNUSED	22	0	0	0	0	False	0
3	501	636499	EICHELBERGERS INC.	SICO - TURKEY HILL #125	ABANDONED	UNUSED	22	0	0	0	0	False	0
4	502	637132	EICHELBERGERS INC.	SICO - TURKEY HILL #125	ABANDONED	UNUSED	22	0	0	0	0	False	0
5	794	548162	MYERS BROS DRILLING CONTRACTORS INC	Brady	WITHDRAWAL	DOMESTIC	200	0	84	6	30	False	2
6	3422	622632	EICHELBERGERS INC.	NORFOLK SOUTHERN	ABANDONED	UNUSED	36	0	0	0	0	False	0
7	3614	17578	HARRISBURG'S KOHL BROS INC	YINGST GERALD	WITHDRAWAL	COMMERCIAL	120	0	50	6	0	False	40
8	4300	634123	EICHELBERGERS INC.	TURKEY HILL	OBSERVATION	UNUSED	21	0	6	4	0	True	0
9	4301	634121	EICHELBERGERS INC.	TURKEY HILL	OBSERVATION	UNUSED	21	0	6	4	0	True	0
10	4577	490440	EICHELBERGERS INC.	THERAL CRAIG	WITHDRAWAL	DOMESTIC	100	0	40	6	29	False	30
11	4879	560427	PENNERS WELL DRILLING	conrail	WITHDRAWAL	DOMESTIC	0	0	0	0	0	False	0
12	4880	560428	PENNERS WELL DRILLING	conrail	WITHDRAWAL	DOMESTIC	0	0	0	0	0	False	0
13	4898	560429	PENNERS WELL DRILLING	conrail	WITHDRAWAL	DOMESTIC	0	0	0	0	0	False	0
14	7679	561173	TALON DRILLING COMPANY	usace penndot	MONITORING	OTHER	33	0	0	0	7	False	0
15	7680	561173	TALON DRILLING COMPANY	usace penndot	WITHDRAWAL	DOMESTIC	33	0	0	0	7	False	0
16	7947	631183	EICHELBERGERS INC.	TWIN ARCHES LTD.	WITHDRAWAL	DOMESTIC	52	0	44	6	0	True	6
17	7948	631183	EICHELBERGERS INC.	TWIN ARCHES LTD.	WITHDRAWAL	DOMESTIC	52	44	52	8	0	True	6
18	9633	17839	UNKNOWN	PENNSY SUPPLY	WITHDRAWAL	INDUSTRIAL	700	0	40	10	0	False	450
19	9634	17841	UNKNOWN	WHITTOCK SAND PLANT	WITHDRAWAL	INDUSTRIAL	120	0	0	6	0	False	250
20	9641	17574	UNKNOWN	HARRISBURG INTERNATI	DESTROYED	UNUSED	225	0	0	6	0	False	200
21	9644	17840	UNKNOWN	PENNSY SUPPLY	WITHDRAWAL	INDUSTRIAL	500	0	40	8	0	False	200
22	11524	88466	HARRISBURG'S KOHL BROS INC	YINGST JERRY	WITHDRAWAL	DOMESTIC	120	0	50	6	30	False	40
23	11527	88473	HARRISBURG'S KOHL BROS INC	EGRISITS JOSEPH	WITHDRAWAL	DOMESTIC	80	0	60	6	50	False	20
24	11529	88482	HARRISBURG'S KOHL BROS INC	BOSNYAK WM G	WITHDRAWAL	DOMESTIC	140	0	40	6	30	False	15

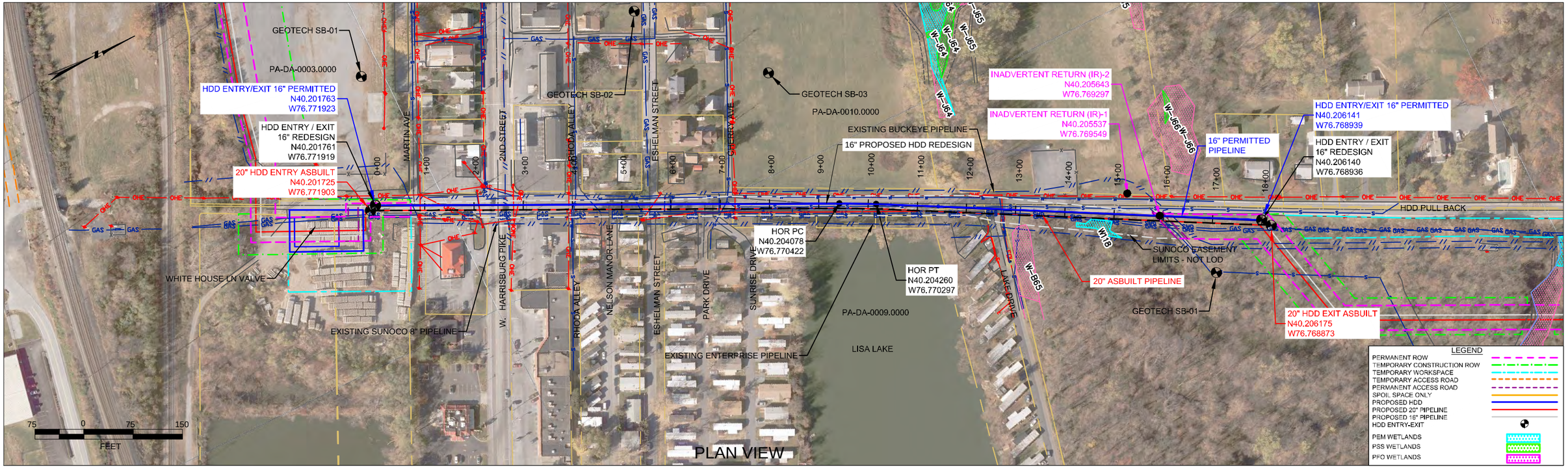
ATTACHMENT 3
WELLS WITHIN 0.5 MILES OF PROPOSED 16" HDD TRACE - SUNOCO WHITE HOUSE LANE
FROM PAGWIS DATABASE 2-12-19

FID	OBJECTID	PAWellID	StaticWate	WaterLevel	LengthOfTe	YieldMeasu	FormationN	Remark
0	467	637312	0					WELL ID: MW13
1	468	637313	0					WELL ID: MW14
2	500	636500	0					SEALING MATERIALS: 188lbs cement; 16.67lbs Bentonite; 12gallons water.SEALING METHOD: Pumping through tremie pipe at well bottom.
3	501	636499	0					SEALING MATERIALS: 188lbs cement; 16.67lbs Bentonite; 12gallons water.SEALING METHOD: Pumping through tremie pipe at well bottom.
4	502	637132	0					SEALING MATERIALS: 188lbs cement; 16.67lbs Bentonite; 12gallons water.SEALING METHOD: Pumping through tremie pipe at well bottom.
5	794	548162	0			VOLUMETRIC WATCH & BUCKET		
6	3422	622632	0					MATERIALS USED TO ABANDON 8" WELL: 846LBS CEMENT; 50 LBS BENSEAL;59 GALLONS WATER; 320 LBS SAKRETE. METHOD OF ABANDOMENT: PUMPING THROUGH TREMIE PIPE FROM WELL BOTTOM.
7	3614	17578	20	120	1		GETTYSBURG FORMATION	
8	4300	634123	0					WELL ID: MW3
9	4301	634121	0					WELL ID: MW2
10	4577	490440	10	70	30	VOLUMETRIC WATCH & BUCKET		
11	4879	560427	0					Note: Coordinates are approximate. A second location based on the driller sketch was placed more than 4000 feet away from this location.
12	4880	560428	0					Note: Coordinates are approximate. A second location based on the driller sketch was placed more than 5000 feet away from this location.
13	4898	560429	0					Note: Coordinates are approximate. A second location based on the driller sketch was placed more than 4000 feet away from this location.
14	7679	561173	0					MW-ERM13S LOCATED NEAR PSU OLMSTEAD BLDG
15	7680	561173	0					MW-ERM13S LOCATED NEAR PSU OLMSTEAD BLDG
16	7947	631183	18	8	30	VOLUMETRIC WATCH & BUCKET		
17	7948	631183	18	8	30	VOLUMETRIC WATCH & BUCKET		
18	9633	17839	20	140			GETTYSBURG FORMATION	
19	9634	17841	20				GETTYSBURG FORMATION	
20	9641	17574	20	23			GETTYSBURG FORMATION	
21	9644	17840	20				GETTYSBURG FORMATION	
22	11524	88466	20		1	UNKNOWN	GETTYSBURG FORMATION	
23	11527	88473	35		1	UNKNOWN	GETTYSBURG FORMATION	
24	11529	88482	55		1	UNKNOWN	MARTINSBURG FM (SHALE)	

WHITE HOUSE LANE CROSSING
PADEP SECTION 105 PERMIT NO. E22-617
PA-DA-0005.0000-RD-16
(SPLP HDD No. S3-0011-16)

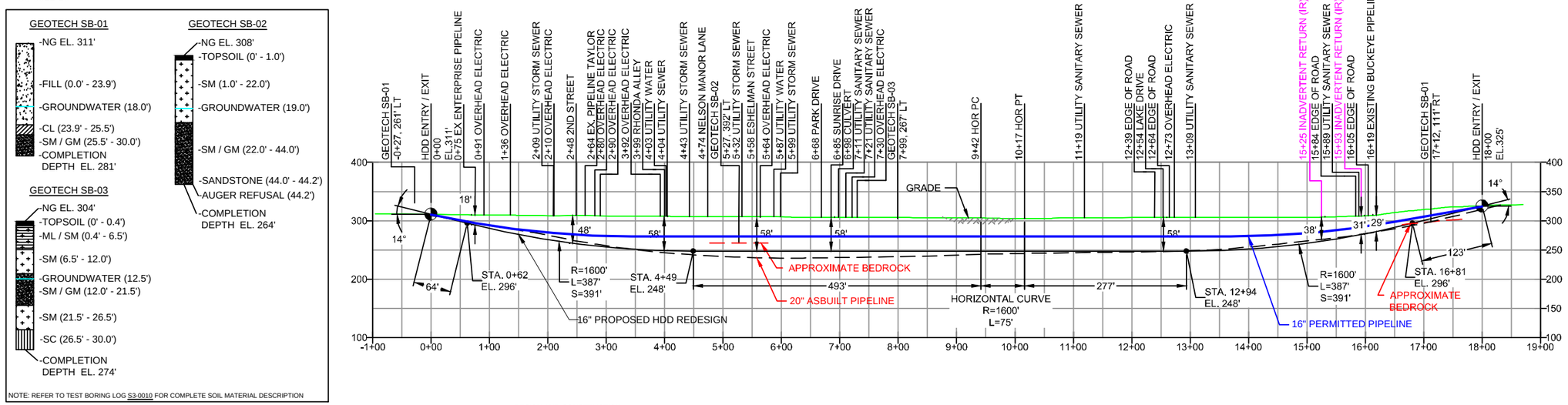
ATTACHMENT 2

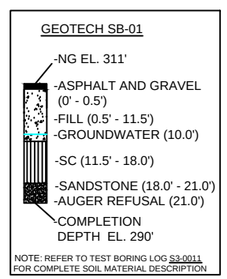
HORIZONTAL DIRECTIONAL DRILL PLAN AND PROFILES



PLAN VIEW

PROFILE VIEW





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=): 1800'
   HDD PIPE LENGTH (S=):1814'
   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.
12. SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
13. SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

Figure 1. Permitted 16-Inch Plan and Profile with 20-Inch IR Data

DAUPHIN COUNTY, PENNSYLVANIA - LOWER SWATARA TOWNSHIP
S3-0011-16

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
6	DESIGN CHANGE - INCREASED DEPTH OF DRILL	MRS	03/15/17	RMB	03/15/17	AMC	03/15/17
5	REVISED PROFILE WITH 2017 LIDAR	MRS	02/24/17	RMB	02/24/17	AAW	02/24/17
4	UPDATED SUNOCO EASEMENT LIMITS - NOT LOD	MRS	10/24/16	RMB	10/24/16	AAW	10/24/16
3	DESIGN CHANGE - SHORTENED DRILL	MRS	09/28/16	RMB	09/28/16	AAW	09/28/16
2	REVISED PER ENGINEERING COMMENTS	MRS	08/31/16	RMB	08/31/16	AAW	08/31/16
1	UPDATE DRILLING NUMBER	DLM	07/14/16	RMB	07/14/16	AAW	07/14/16

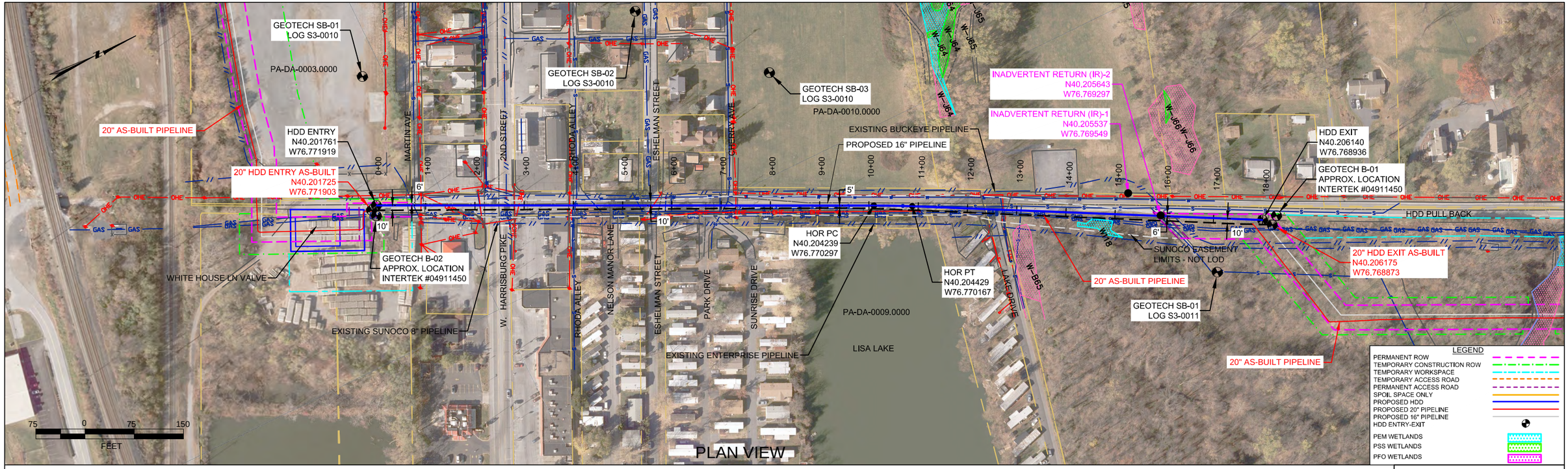
Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

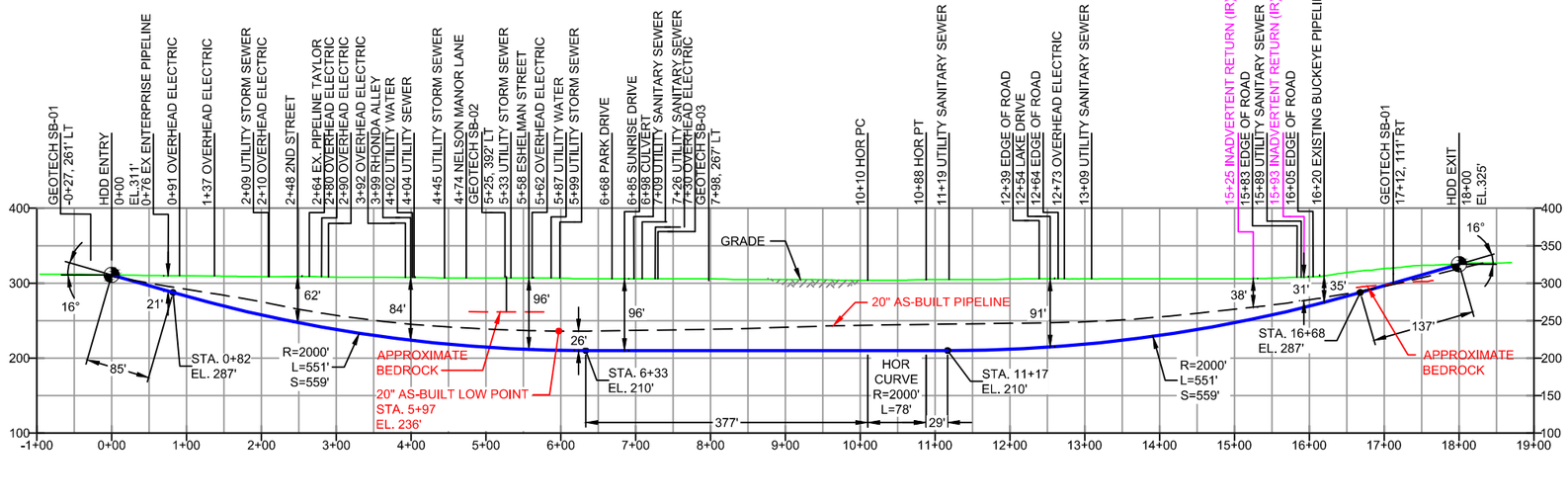
HORIZONTAL DIRECTIONAL DRILL
WHITE HOUSE LANE
PENNSYLVANIA PIPELINE PROJECT

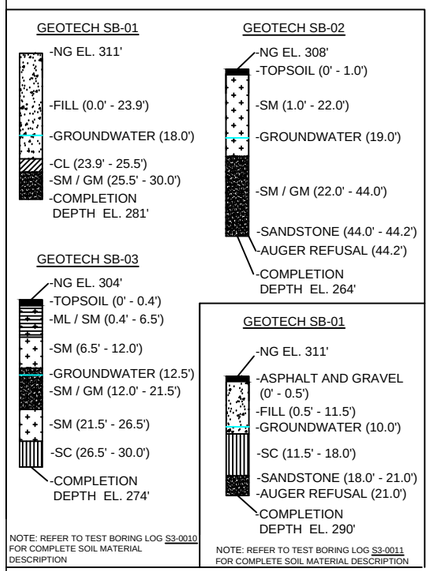
SCALE: 1"=150' | DWG. NO: PA-DA-0005.0000-RD-16 IR EXHIBIT



DAUPHIN COUNTY, PENNSYLVANIA - LOWER SWATARA TOWNSHIP
S3-0011-16

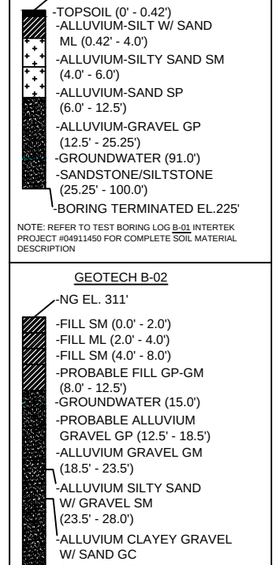
PROFILE VIEW





NOTE: REFER TO TEST BORING LOG S3-0010 FOR COMPLETE SOIL MATERIAL DESCRIPTION

NOTE: REFER TO TEST BORING LOG S3-0011 FOR COMPLETE SOIL MATERIAL DESCRIPTION



NOTE: REFER TO TEST BORING LOG B-01 INTERTEK PROJECT #04911450 FOR COMPLETE SOIL MATERIAL DESCRIPTION

NOTE: REFER TO TEST BORING LOG B-02 INTERTEK PROJECT #04911450 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=):1800'
   HDD PIPE LENGTH (S=):1824'
   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.
12. SUNOCO PIPELINE, L.P.'S HORIZONTAL DIRECTIONAL DRILL INADVERTENT RETURN CONTINGENCY PLAN WILL BE IMPLEMENTED AT ALL TIMES.
13. SUNOCO PIPELINE, L.P.'S EROSION AND SEDIMENTATION CONTROL PLAN WILL BE IMPLEMENTED AT ALL TIMES.

Figure 2. Redesigned 16-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

ES-4.06	TO	ES-4.07	EROSION & SEDIMENT PLAN
SHEET 4	TO	SHEET 4	AERIAL SITE PLAN
DWG NO		DWG NO	DESCRIPTION

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP3	DESIGN CHANGE - INCREASED DEPTH OF DRILL, ADDED GEOTECH DATA	MRS	12/14/18	RMB	12/14/18	AMC	12/14/18
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	MRS	10/21/16	RMB	10/21/16	AAW	10/21/16
EP1	REVISED PER PADEP COMMENTS	DLM	05/09/16	RMB	05/09/16	AAW	05/09/16
EP		DLM	02/26/16	RMB	02/26/16	AAW	02/26/16
B	ADDED GEOTECH INFO	MRS	09/18/15	RMB	09/18/15	AAW	09/18/15
A	ISSUED FOR BID	MRS	08/31/15	RMB	08/31/15	AAW	08/31/15

Sunoco Logistics Partners L.P.

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SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
WHITE HOUSE LANE
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=150'

DWG. NO: PA-DA-0005.0000-RD-16