SUNOCO PIPELINE
An ENERGY TRANSFER Company

535 Fritztown Road
Sinking Spring, PA 19608

May 21, 2018

Via Electronic Mail
Mr. John Hohenstein, P.E.
Chief, Dams and Waterway Section
Pennsylvania Department of Environmental Protection
2 East Main Street
Norristown, PA 19401

Re: SPLP Response to Comments
Hydrogeological Reevaluation Report
Valley Road Crossing HDD (S3-0591)
DEP Permit Nos. E23-524
Middletown Township, Delaware County, Pennsylvania

Dear Mr. Hohenstein:

In compliance with the Corrected Stipulated Order dated August 10, 2017 a Reevaluation Report on the above-referenced horizontal directional drill ("HDD") was submitted to the Department on January 23, 2018. In a letter dated March 23, 2018, the Department has requested further information. Please accept this letter as a response. Your requests are bolded below followed by the response.

1. **Surface geophysics should be employed to provide evidence of the top of bedrock along the whole run of the pipeline. The five geotechnical borings installed, while very useful in determining fracture density and lithology, are insufficient to determine the top of bedrock outside of their sample locations.**

   SPLP believes the five geotechnical bores provide more than adequate information on the depth of bedrock between the ends of this proposed HDD. As stated in the Hydrogeological Report, bedrock is at 63 (foot) ft below ground surface (bgs) at the west end, and 33 ft bgs at the east end, with three other data points indicating bedrock at 18-39 ft bgs between the two ends.

   Considering that the 20-inch profile has an average horizontal depth of 104 ft bgs, and the 16-inch profile has an average horizontal depth of 143 ft bgs, the five geotechnical bores demonstrate that both profiles will be located significantly below the top of bedrock across the entire run of this HDD.

2. **A borehole geophysical suite should be performed in geotechnical borings to determine any local fracture sets that exist which may help determine preferential pathways of groundwater and potential drilling fluids.**

SPLP believes there is enough information from the geotechnical borings already performed, supplemented by the peer-reviewed literature, to determine likely subsurface fluid flowpaths. SPLP believes that the risk of creating new preferential pathways for fluid migration through the installation of a suite of boreholes along the drill path significantly outweighs the marginal utility of any additional information that could be derived from borehole geophysics.

3. Please provide a comparison of original pipeline construction statistics compared to the reevaluated construction statistics.

As shown in the Reevaluation Report, the revised HDD design information, and adjustments are summarized below:

Revised Horizontal Directional Drill Design and Revision Summary: 20-inch

• Horizontal length: 4,266 feet (ft)	No change in total length
• Entry/Exit angle: 14-15 degrees	Entry/exit angle increased 4-5 degrees
• Maximum Depth of cover: 188 ft	Maximum depth increased by 80 ft
• Depth under roads: 75-126 ft	Depth under roads increased by 30-45 ft
• Depth under streams: 71-129 ft	Depth under streams increased by 40-44 ft
• Depth under wetlands: 100-110 ft	Depth under wetlands increased by 34-40 ft
• Pipe design radius: 2,400 ft	Radius into horizontal run decreased by 400 ft

Revised Horizontal Directional Drill Design and Revision Summary: 16-inch

• Horizontal length: 4,232 feet (ft)	HDD length increased by 9 ft
• Entry/Exit angle: 14-15 degrees	Entry/exit angles increased 4-5 degrees
• Maximum Depth of cover: 188 ft	Maximum depth increased by 60 ft
• Depth under roads: 68-148 ft	Depth under roads increased by 11-57 ft
• Depth under streams: 91-146 ft	Depth under streams increased by 55 ft
• Depth under wetlands: 90-110 ft	Depth under wetlands increased by 39-50n ft
• Pipe design radius: 2,000 ft	Radius into horizontal run decreased by 400 ft

In summary, the revised HDD designs increase overall depth of profile as well as depth below surface features and increased entry/exit angles to the land surface and angle of proceeding to horizontal depth.

4. The GES Report was signed and sealed by a P.G. It made several recommendations that were not incorporated into the First Report, which was not sealed by a professional of any kind. This includes:

a. The construction of a dedicated drainage way to the nearest surface water conveyance should drilling fluid overflow the dedicated containment area. This would require additional DEP permitting.

The Department's recital of this recommendation is incorrect. GES did not recommend construction of a drainage in case of "drilling fluid overflow", nor would SPLP request a permit to allow such an event, but rather this recommendation concerned the management of "excess groundwater" returning to the HDD entry pit, during periods of no drilling.

SPLP's definition of "excess groundwater" during a HDD is the production of groundwater within the annulus of the HDD while underway that exceeds the water consumption requirements during drilling activities. This water would be blended with the drilling fluids and would be considered an "industrial waste" by the Department and could not be freely discharged without prior filtration and cleaning to meet regulatory standards for free discharge.

To manage the potential occurrence of excess groundwater during drilling, the HDD contractor will stage large capacity holding tanks at the HDD entry workspace and then employ a fleet of trucks to load and transport the water to an approved water treatment facility. During periods of non-drilling, the contractor can elect to either continue to transport the way away for disposal, or my elect to set a plug or hole packer into the drilled hole to seal off water flows.

b. The First Report states that landowners should make advanced arrangements for the supply of alternative water sources. However, the GES Report and the Inadvertent Return PPC Plan incorporated into the February 6, 2018, Consent Order and Agreement entered into between Sunoco and DEP provides that Sunoco will offer to supply water to these residents prior to drilling. DEP considers the latter two documents to be controlling. Sunoco shall proceed as set forth in the GES Report and the February 6, 2018, Inadvertent Return PPC Plan.

The Department has misinterpreted what is stated in the "First Report" regarding arrangements for alternative water sources. The First Report does state "landowners should make advanced arrangement for the supply of alternative water sources"; however, within the entire paragraph, this statement is made in the context of SPLP contacting these landowners and working with them to make arrangements for alternative water supplies at SPLP expense in accordance with SPLP's Operations Plan and the April 2018 Inadvertent Return PPC Plan.

c. The implementation of the early detection groundwater monitoring program using domestic wells described in the GES Report was not incorporated into the First Report. For additional clarification, please provide a map of the domestic wells, along with a time frame of drilling activities, within the monitoring plan.

A new Water Supply Illustration is provided with this response as Attachment 1. As shown on this illustration there are twenty-six (26) landowner identified private water wells within 450 ft of the HDD profile. Of these, two (2) have public water as a primary water source, and

SPLP is confirming if an additional two properties have public water as the primary water source. The remainder of the properties within 450 ft of the HDD profile are served solely by public water supply.

During active drilling, SPLP implements regular monitoring of adjacent water wells. Additionally, SPLP agents are "on-call" and immediately respond to any individual in vicinity to an HDD complain about a water quality or quantity issue in accordance with the project's Operations Plan and Water Supply Plan. The duration of this HDD is anticipated at 95-120 days varying by actual conditions encountered while drilling.

d. No mention was made in the First Report to suggest that areas of concern would be monitored with any greater frequency during drilling activities. The Report needs to describe the prescriptive measures to be employed for each area of concern, including, but not limited to, the number of observers, and the distance of the drill bit from the areas of concern.

SPLP employs a staff of multiple PGs and Environmental Inspectors to patrol and monitor the HDD during active drilling. Both the PGs and EIs are provided the geotechnical background information which is utilized to orientate additional scrutiny of surface patrolled locations. Based on experiences on nearby HDDs and IR events, the distance of the drill bit relative to an IR event is irrelevant. Although SPLP has identified locations of formation changes and fracture lines as suspect locations for IR events, the location of the drilling tools when an IR event occurs has not had a direct correlation to date.

e. Specific points of potential weak bedrock and soils were not individually identified. This should be done. Predetermined areas of weakness should be addressed by a description of the prescriptive approach Sunoco will use when drilling. For example, when a certain waypoint is reached in the boring, drilling fluid pressures should be automatically adjusted.

As stated in the response to Item 1 above, the 20-inch profile has an averaged horizontal depth of 104 ft bgs, and the 16-inch profile has an averaged horizontal depth of 143 ft bgs. SPLP and the Department understand from the results of the geotechnical cores that the bedrock quality gradually improves with depth and the quality data is relatively consistent between the west and east ends of the HDD. However, areas of bedrock/soil weakness consist of fractures and joints, zones of weathering, and areas of formational transitioning do occur, all of which can be predicted with fair success using available resources. These resources include fracture trace analysis, existing geologic and hydrologic studies, and the geotechnical borings already performed. Familiarity with this information allows reasonable prediction and interpolation of zones of weakness, which will be discussed ahead of drilling, with a plan devised to address such zones, and monitored closely as drilling progresses, per the Operations Plan and revised IR Plan. For example, the HDD operator will use an Annular Pressure Monitor (APM), to actively observe conditions in the profile while drilling. An abrupt drop in annular pressure, which is indicative of a potential IR event, and in accordance with the IR Plan,

requires the drilling to stop, assess down hole conditions, and implement a cure to the problem based upon the drilling data.

SPLP does not believe that there are additional technically feasible methods to acquire additional useful data that would identify zones of weakness at the average depth of the pilot hole (104-143 ft bgs) across the length of the pilot hole (2,472 linear ft).

5. The six (6) recommendations outlined in the geologic report should be fully integrated into the redesign plan. Presently only a portion of these appear to have been included.

The six recommendations from the GES Report are below followed by SPLP's consideration of each recommendation.

1. *Prepare a contingency plan for excess groundwater flow back for the southeastern HDD entry location which would include; 1) a groundwater containment, retention and re-infiltration system to manage potential excess groundwater discharge unable to be recirculated for drilling use, at the drill entry point during HDD shutdown periods;2) a dedicated drainage way to the nearest surface water conveyance (Rocky Run) with appropriate Erosion and Sedimentation controls; and 3) a contingency plan to grout pipe annulus and terminate any ongoing groundwater discharge, if that should occur, post installation.*

As stated above in the response to Item 4a, SPLP's drilling contractors have procedures for controlling excess ground water. SPLP's IR plan already includes measures for grouting of the HDD annulus, and is a listed best management practice within the Reevaluation report.

2. *Establish a communication and response plan to respond to complaints from well owners during HDD activities, confirm any impact from drilling operations and provide alternative water supplies where needed.*

This recommendation is not a geology or hydrogeology task related to the analysis, success, or failure of the proposed HDDs. SPLP, prior to any recommendation from the professional geologist, had directed land agents to engage in this task. The landowner information is updated as agents are able to establish communications and confirm the water source on each tract. The requirements for alternative water supplies is addressed by SPLP's Operations Plan, IR Plan, other project specific documents, and permit conditions.

3. *Identify domestic water supply wells within 150' of the HDD alignment and offer/provide a temporary water supply prior to HDD drilling. The offer would extend prior to and during any portion of the HDD drilling and until completion of the pipe pullback work. Any well suspended from service during the HDD operation would be tested prior to its re-activation to document its water quality compared to pre-drilling conditions.*

This recommendation is not a geology or hydrogeology task related to the analysis, success, or failure of the proposed HDDs. Moreover, the revised Operations Plan and IR Plan require SPLP to offer alternative water supplies to any landowner with identified private water supply wells within 450 ft of the HDD profile. SPLP land agents have already engaged and continue to communicate with private well owners regarding providing alternative water supplies at SPLP's expense for the duration of HDD activities.

4. *Evaluate the feasibility in implementing an early detection groundwater monitoring program using either appropriately located domestic wells (agreement with well owners required) or newly constructed monitoring wells (location logistics dependent) to detect drilling fluid migration toward domestic water supplies within areas of high well density.*

As shown on the Water Supply Illustration has successfully engaged all but two landowners with private water supplies within 450 ft of the HDD profiles. Access for testing and monitoring during the HDDs has been granted by these well owners as indicated. Monitoring during the HDDs is a standard practice.

5. *Provide drilling operators, Environmental Inspectors (EIs) and field Professional Geologists (PGs) with mapping that locates areas where the HDD traverses or is in close proximity to fracture traces and bedrock faulting. These areas can be inspected with increased frequency and drilling operators can more closely monitor pressures when drilling through these horizons.*

This recommendation is already included as a best management practice for these HDDs.

6. *Address the potential for soil and bedrock weaknesses along each revised profile within the updated drilling plan for HDD S3-0591. Specifically identify unconsolidated horizons characterized with low cohesive overburden and the potential for IRs in proximity to HDD entries and exits. Review possible methods to improve mitigation of IRs in these horizons.*

This recommendation is addressed by multiple HDD best management practices. The Hydrogeological Reevaluation Report identifies the location and zones of overburden on Page 11, and the data has been transposed to the HDD plan and profiles. The drilling operator uses this data to guide and manage the entry and exit operations. Overburden thickness varies from 18.5 to 63 ft of depth, varying by location along the profile. Generally, entry into bedrock will occur on the second section of drill stem, and there is no need to use the mud motor until reaching this point. Exiting out of bedrock will occur 10 sections of drill stem before exiting. Again, at this point in the profile minimal use of the mud motor is required and steering corrections would be minimal or unnecessary.

6. Please provide further communication with the drilling company that may clarify what happened on the core run from 185.5 to 195.5 (Elev. 169.5 to 159.5) on hole B6-2W. The

log shows the RQD as not recorded. They did recover 118 inches of a 120-inch run, and described and photographed the core that was recovered. The geologic report discusses the RQD as zero which implies that there may be some anomaly or problem with the rock at that depth when that may not be the case.

SPLP is unsure why the version of the geotechnical data included in the publicly posted data is different than our copy of the same report. The RQD for this depth is "83" and we have included this page as Attachment 2 of this response.

7. **The 150-foot "impact area" relied upon in the Report does not appear to be supported by site specific Geologic or Hydrologic data or other competent data. Provide the basis for this determination.**

   As a result of the Consent Order Agreement executed February 8, 2018, SPLP has authored and DEP has approved a new Operations Plan that provides that SPLP will offer all landowners with only a private water supply source located within 450 ft of the HDD alignment, an alternative temporary water supply. Accordingly, the previous statement concerning the potential effects within 150 ft is now moot. In accordance with the Operations Plan, SPLP has made this offer via letter to the 24 landowners with identified private water supply wells within 450 ft of the HDD profile. SPLP's offer to the landowners for the temporary supply of water during the HDD operations will remain open until HDD operations are complete. Moreover, in accordance with its Chapter 105 permit, during HDD activities SPLP will address to the satisfaction of the landowner any landowner complaints concerning water supply that are shown to be associated with HDD activities.

8. **If the prescribed minimum of 15-foot tremie grouting is inadequate to prevent groundwater discharges from the HDD annulus, explain what additional measures will be employed.**

   SPLP has not had a failure of a correctly assessed and completed grout closure of an HDD annulus on the ME2 project. Each instance is different, varying by water flows, substrate, and annulus volume. The prescribed grout and methodology is adjusted to account for these differences. If a grout closure were only partially successful, then SPLP would perform a vertical proximity grout injection further into profile behind the original grout setting.

9. **The following best management practices (BMPs) should be incorporated into the Report. If Sunoco feels it is inappropriate to include any of these BMPs, Sunoco should provide an explanation as to why it is inappropriate to do so.**

   A response to this item is provided after Item 9i.

a. **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 along the drill path, so that monitoring can be enhanced when drilling through these locations.**

b. **SPLP will require and enforce the use of annular pressure monitoring during the drilling of the pilot hole, which assists in immediate identification of pressure changes indicative of loss of return flows or over pressurization of the annulus, managing development pressures that can induce an IR.**

c. **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.**

d. **SPLP will mandate short-tripping of the drilling tools to ensure an open annulus is maintained to manage the potential inducement of IRs.**

e. **Sunoco will require monitoring of the drilling fluid viscosity, such that fissures and fractures in the subsurface are sealed during the drilling process.**

f. **Based upon the behavior of the soil overburden and near subsurface geology during the entry and exit of the pilot phase, casing of the pilot hole can be implemented to control IR where the profile depth is shallow and oversight of the pilot indicates a long-term risk of IR that should be controlled.**

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

h. **If LCMs prove ineffective to mitigate loss of returns or IRs, then grouting of the pilot hole may be implemented.**

i. **SPLP will prepare and stage the materials required to manage groundwater flow back to the southeastern entry/exit point to control potential groundwater discharge during HDD installations.**

Items 9 "a" through "i" listed above are copied from SPLP's Reevaluation Report for HDD S3-0591 and therefore are incorporated into the Report.

10. **It is also recommended that given the geologic conditions present at this site, and in particular given the prediction that both Sunoco and DEP reviewing geologists have reached, that this HDD has the potential to produce significant quantities of groundwater that would flow back to the entry point, Sunoco should incorporate into**

the Report a provision that provides that during critical drilling phases Sunoco management/technical representatives will be present on site and that DEP regional staff will be provided with adequate advance notice to allow DEP staff to be present.

SPLP has multiple management level and technical personnel dedicated to inspection, oversight, and monitoring of every active HDD project wide; therefore, there is no need to specifically establish the same criteria for these HDDs.

In accordance with the April 2018 version of the IR plan, SPLP provides the Department of advance notice of commencing all HDDs project wide.

11. The Re-Evaluation Report should include additional details such as pilot bore and reaming diameters, annular pressures, mud viscosities, action levels, and specific IR response actions should be included.

The typical mud motor cutting tool diameter used for HDDs of this linear extent is 12.3 inches in diameter; however, it is the drilling contractor choice, based on their experience, on which equipment and tools are used in the drilling phases.

The ultimate reaming diameter for the 20-diameter pipeline is 30 inches. The reaming could be done in incremental diameters ranging from 16 to 24-inches before progressing to a 30-inch diameter ream. The ultimate reaming diameter for the 16-inch pipeline is 24-inches in diameter, which typically is not pre-reamed at a smaller diameter. The decision to pre-ream at smaller diameters, or not, is based upon real time data acquired during the pilot hole phase.

Annular pressures vary by depth of profile due to the effect of gravity, increasing as the depth of profile increases. At profile depth the annular pressure could vary between 50 and 90 pounds per square inch varying on drilling conditions encountered, and pressures required to maintain the flow of returns.

Mud viscosity is measured using a "Marsh Funnel" which is based on time in seconds for 1-quart of fluids to pass through the funnel. In common terminology, viscosity typically varies from 5-15% percent varying by the nature of the material being drilled through so that continued removal of the cuttings within the annulus is efficient. What is actively managed in the drilling process is not only viscosity, but returning mud weight so that the cuttings removal is verified before recycling the drilling fluids into the HDD process. The target cleaning level of the drilling fluids is 9.5-10.5 lbs per gallon.

There are no pre-set "action levels" in an HDD except as discussed above. An HDD is an actively managed process.

Responses to an IR event would adhere to the procedures of the latest version (April, 2018) of the *"Pennsylvania Pipeline Project: HDD Inadvertent Return Assessment, Preparedness, Prevention and Contingency Plan* (IR Plan)".

12. The Re-Evaluation Report states that loss control materials (LCM) can be used to manage the loss of fluids during the pilot hole phase. The discussion also states that loss of fluids may be managed by grouting. A discussion of the timing of the potential grouting program is not provided. Grouting of highly fractured zones of rock or fracture traces as a preventative measure may be prudent, whereas, grouting after an inadvertent return (IR) already occurs may not be desirable. If grouting is necessary, it may be better to identify and remediate the zones along the alignment that should be grouted prior to drilling the pilot holes. A conceptual description of the proposed grouting program, if any, would be helpful.

The use of Loss Control Materials (LCMs) cannot be "pre-planned" since it is impossible through the use of existing technologies to precisely determine where below ground conditions occur that would warrant an application of LCM's in advance.

Due to this inability to "pre-determine" a location in an HDD profile where an application of LCMs would be appropriate, the HDD operator uses tooling, in this instance the Annular Pressure Monitor (APM), to actively observe conditions in the profile while drilling. An abrupt drop in annular pressure, which is indicative of a potential IR event, and in accordance with the IR Plan, requires the drilling to stop, assess down hole conditions, and implement a cure to the problem based upon the drilling data.

LCMs are mixed as a "pill" to use the industry term. A pill is a tank mixed LCM volume of drilling fluids with the LCM introduced, typically 1,000 to 2,000 gallons in volume that is pumped through the stem to the point of injection, then followed by a batch of normal drilling fluids to set the pill and clear the stem. LCMs work best in minor fissures and bedding plan partings.

The use of grouting cannot be "pre-planned" since it is impossible through the use of existing technologies to precisely determine where below ground conditions occur that would warrant a grout injection in advance. The APM tool is used for this purpose. Depending on the specific circumstances while drilling, a grout injection may be the only solution to resolve an occurrence of an IR. SPLP does not "desire" any IRs and the whole objective of the Reevaluation process is to eliminate or minimize the potential occurrence of an IR during an HDD.

The determination for the use of grouting or LCM's is all based upon the downhole data recorded while drilling. Minor Loss of Circulation (LOC) events, indicative of fractures or larger bedding plan partings in the bedrock, can be effectively treated using a combination of NFS 60 certified fluids with control properties such as "SuperSwell" and "Magma Fiber". Set time requirements are relatively short before re-advancement of the tool can commence.

Significant fractures or voids can require multiple grout injections before a plug could be set, and advance of the drill could recommence. Where fractures and voids are sufficiently large, the typical grout injection only fills the bottom of the opening because of gravity and size of the opening.

The recommended treatment procedure for large fractures and voids during this HDD will be the use of a low mobility grout based on bentonite types of products such as "Hole Plug" and "Bore Grout". Grout placement would utilize standard mixing and pumping techniques. The objective of the grouting program is to get as much of the bentonite chips into the fracture as possible but limiting the individual placement volumes to between 3 and 5 times the theoretical hole volume using a 'packer' system to prevent grouting areas that are not in the immediate vicinity of the fracture or void. Fill of the voids using multiple limited volume injections will allow the grout to layer up in the crack or void and eventually fill the opening sufficiently for a seal to develop. Sealing of the opening will be identified when the pump pressure increases during the next grout placement. When backpressure is identified on the last grout injection, the hole has been sealed and drilling may resume after allowing for set time.

13. IR prevention typically includes linking the respective proposed HDD geometry with site-specific geotechnical data. This approach will allow the HDD designer and driller to understand what specific HDD station ranges will be most vulnerable to IRs. Questions regarding the linking of the proposed HDD geometry and the site-specific geotechnical data for this specific bore include the following.

a. Has the possibility of IRs via weak subsurface soil/weathered rock/fill zones at existing utility trenches (if present) been considered?

Existing utility lines that would be undercrossed by the HDD while the HDD is above bedrock includes a water line at Station 1+66, with the HDD at 35 ft of depth below ground surface (bgs). This line is in near proximity to the exit pit, which is not a point of high pressure during drilling or once the pilot phase has passed this point in the profile.

The remaining utility under crossings by the HDD profiles are substantially deeper and not of concern for the stated issue.

b. The Re-Evaluation Report states that "Based upon the behavior of the soil overburden and near subsurface geology during the entry and exit of the pilot phase, casing of the pilot hole can be implemented to control IR where the profile depth is shallow and oversight of the pilot indicates a long-term risk of IR that should be controlled." Based on the occurrence of at least four (4) recent IRs in nearby HDDs, the use of casing in the pilot hole at the entry and exit points should be mandated by Sunoco.

The existing location conditions and design parameters for every HDD are site specific. SPLP cannot determine which HDDs or their specifics the Department is referencing in Item 13b; however, the Department should note the on these HDDs the acute entry angle and shallow depth of bedrock which minimizes the extent of drilling before bedrock entry. These specific could result in no requirement for casing for this specific HDD.

14. Page 2 of the Terracon Report (Attachment 2 of GES Report) states: "When laboratory soil testing results are available, we will submit a complete data report for the subject crossing." This report appears to be preliminary, and an update may be available by now. Any final report from Terracon should be offered as part of the Re-Evaluation Report.

The December 21, 2017 version of the Terracon report is the most up to date version in our possession. SPLP is inquiring with this contractor on a final report as referenced.

15. Soil laboratory testing results for B6-2E and B6-2W, if any, are missing. Supporting lab testing reports that could be used to support designs near entry and exit stations are not provided. Are lab test results now available?

Laboratory test results for soils above bedrock do not affect the design of an HDD. The key item affecting an HDD design is the pipe factors; then bedrock character and qualities. SPLP is inquiring on the soil tests as referenced in the response to Item 14.

16. This plan is to address a specific HDD bore at a specific location. Previous history with IRs in this area suggests that soil cover alone may not provide sufficient resistance to prevent future IRs and that a profile that penetrates sound rock may be more appropriate. As a result, discussion regarding sufficient depth of soil cover versus maximum allowable mud pressure should be included for portions of the HDD where the HDD path does not penetrate rock. The discussion of sufficient depth of soil cover versus maximum allowable mud pressure is especially important in the area where the HDD bores will cross stream S-C40, give the stream, a mapped fracture, and variable depth of weathered bedrock coincide.

Stream S-C40 conveys overflow from an impoundment of a minor topographic valley on the northeast side of Valley Road at this location, and it is not a "natural stream". This "stream" occurs at HDD Station No. 30+94 and is located 124 ft west of Geotech Core B6-2E. The 20-inch HDD profile is 71 ft below the stream channel and the 16-inch profile is 91 ft below the stream channel. Cross referencing the geologic data from Core B6-2E requires subtracting approximately 20 ft off the surfaced elevation and corresponding core data, resulting in a depth of bedrock to profile of approximately 46 ft. Bedrock qualities improve from 54 ft to

depth of profile at 79 ft. Recovery value transitions from 97 to 100, and RQD value transitions from 71 to 94. SPLP's analysis is that the 20-inch profile is set below 25 ft of bedrock with good quality values and the 16-inch profile is set 45 below bedrock with good quality values. There is not a fracture trace intersect where the HDD profiles pass under this conveyance and since the stream is not a result of a "natural fold" in the landscape this location does not appear to be a weak spot in the profile.

17. The Re-Evaluation Report states "No geophysical studies were recommended or performed due to lack of karstic terrain." Geophysical surveys should not be limited to karst environments, as they may be useful and provide valuable data in this instance. Specifically, a geophysical survey could be helpful to interpolate between geotechnical boring points, identifying areas of soft soils, better defining the top of competent rock and in delineating/characterizing the fractures identified by GES.

Geophysical assessments provide only limited data below bedrock levels even in karst formations, and are utilized more appropriately as a "tool" to identify locations for drilled core investigations of suspect fractures and voids in karst formations.

As discussed in the response to Item 6 above, SPLP has performed a suite of geophysics studies at five (5) locations. These were performed at four (4) locations with karst geology, and one (1) location of 1/3rd karst and 2/3^{rds} non-karst geology. At the five karst locations, the results of the geophysics provided usable data to a depth of 15 ft to 60 ft bgs. At the non-karst location, the geophysics indicated voids and soft spots were subsequently investigated by cone penetrometers and geologic coring. The physical investigation resulting in complete invalidation of geophysics indicated soft spots and voids.

Since that the 20-inch profile has an average horizontal depth of 104 ft bgs, and the 16-inch profile has an average horizontal depth of 143 ft bgs, based on SPLP's experiences, geophysics will provide no functional data at this non-karst HDD location.

18. Evaluation of water levels should be performed prior to initiating the HDD bore to provide information regarding potential diminution of flow issues and the ability to determine if any future potential impact is related to head differentials or plugging of a potential water-bearing zone. Give the developed nature of this area and proximity of residential groundwater supply wells, further discussion is warranted regarding this topic. Potential actions could include the following:

a. Project water well depths, casing depths and water-level depths (based on a water-level survey) on cross sections/profile views.

A set of HDD Plan and Profiles with water well locations, well depths, and water levels transposed onto the profiles is provided in Attachment 3.

b. The GES Report identifies fracture traces on a plan view. The Re-Analysis Report should also identify potential zones of fractures or fracture trace intercepts, and the residential water supply wells on the plan view and profile view figures.

A set of HDD Plan and Profiles with the fracture trace lines and water well locations transposed onto the profiles is provided in Attachment 3.

c. The Re-Analysis Report should include a specific plan for temporary supply replacements, as the bedrock is highly fractured, even at depth, and residential water supply wells are located as close as 42 feet from the planned bore path. To limit potential impact on residential water well users, there should be a well-conceived response plan in place and ready to execute.

SPLP has committed to using Aquabloc as a component of the drilling fluid mix for these HDDs as a direct measure to prevent damage to adjacent private water wells. SPLP agents will be monitoring the water wells during HDD activities, and if necessary the provisions and requirements of the Operations Plan, IR Plan, and Water Supply Plan will be engaged to immediately respond to replace water supplies with temporary supplies and mitigate further damage to private water supplies. In accordance with these plans as referenced, and the project's permit conditions, any impacts to private water supplies will be corrected at SPLP's expense to the satisfaction of the landowner.

19. Figure 4 of the GES Report appears to be an earlier version and conflicts with what appears to be a later version of the same figure located in Attachment 2 of the GES Report. Figure 4 includes a table listing 20 wells, while the later version in Attachment 2 lists 28 wells. In addition, the text of the GES Report (Section 2.3.4) includes reference to 18 homes identified by the PAGWIS search, and then describes 28 properties & 20 domestic wells within the 450-ft search area. Based on the figure in Attachment 2 of the GES Report, DEP believes 83 properties are located within 450 feet of the proposed HDD, 28 of which have private water supply wells. These discrepancies should be clarified and SPLP should confirm that all private water supply owners have been contacted.

As referenced in Item 4 of this response, an updated Water Supply Illustration is provided as Attachment 1. As shown on this illustration there are 24 tracts with private water wells, of which 2 have public water as a primary source, and 2 additional tracts potentially have public water as a primary source.

20. The Re-Evaluation Report indicates Sunoco will monitor downhole pressures, viscosities, mud loss, and nearby water wells. However, there are no specific values or action levels such as how often mud loss is calculated or what viscosity would be maintained during the bore or at what point an IR contingency plan would be implemented (i.e., if there is X pressure increase or X mud loss, an IR contingency plan

would be started). The specific viscosities and action values and pressures should be defined and documented to facilitate prompt actions during the HDD bore.

SPLP is committed to following the practices and procedures of the April 2018 version of the IR Plan. The IR plan contains procedures for monitoring and reporting on Loss of Circulation (mud loss). As answered in Item 11 above, mud viscosity typically varies from 5-15% percent varying the nature of the material being drilled through so that continued removal of the cuttings within the annulus is efficient. What is actively managed in the drilling process is the mud weight so that the cuttings removal is verified before recycling the drilling fluids into the HDD process. The target cleaning level of the drilling fluids is 9.5-10.5 lbs per gallon.

Loss of circulation or returns (mud loss) is continually observed during active drilling. Water use, bentonite volumes added, and mud volume pump rates are tracked during active drilling.

The drilling operator monitors the APM data while drilling. There are no "preset" pressure values. An abrupt pressure spike indicates a clogged annulus and the operator will stop the mud pump to relieve pressure, and the take corrective action, such as tripping back the drill string and tool at minimum pressure to attempt clearing of the blockage, or further actions as necessary, including if needed, the complete removal of the drill string and tooling to clear the hole. An abrupt drop in pressure indicates the penetration of a significant fracture or void or potentially a tool failure. If a loss of circulation occurs at the same time, then that is positive evidence of penetrating a fracture or void. If the data indicates a fracture or void, then the operator will attempt corrective action to seal the feature and restore circulation by using an LCM or grout injection.

21. Although the drilling practices are intended to minimize the risk of an IR occurring, there is a possibility that an IR could reach the ground surface. Given the highly developed nature of this area and the close proximity to residential water supply wells, the Report should reference the current *HDD Inadvertent Return Assessment, Preparedness, Prevention and Contingency Plan.*

The April 2018 version of the IR Plan is the primary document addressing the measure to prevent or minimize the occurrence of IR's, and reporting and responding action requirements in the event of an IR. The IR Plan applies to all HDDs project wide and will be followed at this HDD.

22. The terms pressure, fluid pressure, drilling pressure, mud pressure, etc., may refer to either the injection pressure of the drilling fluid (mud) inside the drill string or to the pressure outside the drill string but within the borehole. Most HDD drillers measure the injection pressure of the mud/drilling fluid within the drill string and do not measure the pressure of the bore outside the drill string but within the borehole. The

Re-Evaluation report should clarify which pressure values are being monitored as part of this proposed HDD bore.

SPLP has mandated that Annular Pressure Monitors will be used on every HDD project wide during the pilot hole phase. The April 2018 version of the IR plan includes this requirement as well. The drilling operator also routinely records pump/stem pressure as part of their standard record keeping.

23. **When applying the cavity expansion model, maximum allowable mud pressures in soil will likely be exceeded near the exit point (and possibly at other locations) due to the length of the bore through which cuttings must be transported. The Re-Evaluation Report should consider options for lowering mud pressures to help minimize the risk of IRs. For example, perhaps the pilot holes could be initiated from both ends.**

Standard drilling best management practices account for the concern of reduced pressures while proceeding down to bedrock as well as exiting bedrock and proceeding to the exit point. The normal procedure is to use minimal pressure to operate the mud motor as needed and to keep the cutting bits from clogging. At the discretion of the driller, and based upon the nature of the overburden material, the driller may elect to not engage the mud motor and use rotational drilling while entering or exiting the HDD profile, again at minimal pressure to prevent clogging of the tools.

24. **As noted in the Re-Evaluation Report, the bore has a reasonable chance of discharging groundwater from the lower elevation bore entry/exit. Groundwater handling has been addressed in a general manner. Also, the grouting plan is very basic. A more detailed plan is required. For instance, Sunoco indicates it will inject a bentonite plug, and then grout. Setting a bentonite plug in a horizontal bore is not as simple as just dropping in some bentonite chips. More importantly, if groundwater is flowing in the bore, it is likely to wash out the grout before it sets, leaving groundwater discharging the bore exit.**

SPLP agrees that groundwater handling was discussed in a general manner in the Reevaluation Report. This is due to the fact it is impossible to predict in advance the potential rate of groundwater production within the annulus of the pilot hole or reamed hole. If grouting of the annulus becomes necessary, then SPLP will provide the Department the opportunity to review the recommended plan in advance of implementation.

25. **Regarding the grouting plan, Sunoco mentions a minimum of a 15 feet bentonite plug to stop the flow if groundwater. DEP recommends a minimum bentonite plug of 20 feet.**

SPLP appreciates the Departments recommendation.

26. The Re-Evaluation Report indicates the viscosity of the drilling fluids will be monitored. More specificity should be provided regarding the viscosity values at which actions will be taken, in order to make it clear to the inspectors to know when conditions are no longer optimal or normal. The Re-Evaluation Report should clearly state that Sunoco will actively monitor the volumes of drilling fluid returns. For example, if the inflows do not match the outflows, there is likely an issue with either a plugged annulus or an IR.

A discussion on mud viscosity and monitoring was provided in the response to Item 11 above.

SPLP will follow the procedures of the April 2018 IR Plan which outlines monitoring procedures during HDD activities.

27. There was a public comment received regarding the location of a private well at 226 Valley Road, in Media PA. The Well Location Map incorrectly locates GES Well ID WL-08102017-604-01 at an offset of 490 feet. The correct offset is 150 feet. Please revise the location and all appropriate action for this well to reflect this revised offset.

The updated Water Supply Illustration in Attachment 1 has been corrected.

28. With regard to water supplies that might be impacted by these HDD activities, Sunoco must address those impacts in an acceptable manner. Sunoco has the option to enter into written agreements with all private water supply owners whose water supplies may be impacted by this Drill, regardless of their location from the Drill, as part of this reevaluation, and in advance of commencing the HDD. Under the agreements, Sunoco must provide short and long-term replacement potable water supplies adequate in quantity and quality for the purposes served, to the satisfaction of all potentially affected water supply owners. The agreements should provide for Sunoco to conduct water quality and quantity testing of each potentially affected water supply prior to, during, and after the HDD activities. Sunoco needs to provide proof of these agreements to DEP with a response to this letter.

Please see the response to Item 29 below.

29. In the alternative, if Sunoco chooses not to pursue these agreements with the private water supply owners, it must provide a discussion of actions to be taken by Sunoco to prevent water supply impacts from occurring. Sunoco needs to demonstrate how, in the absence of the agreements described above, Sunoco will avoid impacts to all water supplies. Sunoco's approach should include the utilization of technical and nontechnical measures to avoid such impacts, including, but not limited to, the conversion of the HDD to a trench installation, use of other trenchless construction methods, the use of NSF-60 approved gels or other approved additives that could prevent such impacts from the Drill, or some combination of all of the above. To the extent Sunoco proposes to use any ANSI/NSF 60 certified HDD additives, consistent

with Special Condition NN contained in DEP Permit Nos. E23-524 and E15-862, Sunoco will only be able to use the additives in the manner indicated in the certification of the proposed additive. The manner in which the proposed additive is to be used, as indicated in its ANSI/NSF 60 certification, should be submitted with your response. In addition, Sunoco should indicate whether it will be following all conditions included as part of the additive's certification or, if not, provide an explanation as to why it is not and why that deviation is acceptable.

The new Operations Plan provides that SPLP will offer all landowners with only a private water supply source located within 450 ft of the HDD alignment an alternative temporary water supply.

SPLP provided notice and offered temporary water supplies to all water supply owners within 450 feet of HDD profiles. Significantly, the facts regarding water supply wells within 450 feet of the HDD profile are:

(i) There are twenty-six (26) parcels with a water supply well within 450 feet of this HDD profile, of which two have public water as a primary source, and an additional two possibly have public water as a primary source. All twenty-four landowners have received written notification that they are entitled to temporary water supplies at SPLP's expense.

(ii) So far, two of these landowners have agreed to accept temporary water supply during the HDD process; however, SPLP has not re-approached the outstanding well owners recently, and is in the process of re-contacting these owners.

(iii) Forty-five (45) of these parcels are on public water.

Considering the immediate proximity of public water supplies to the properties reporting private water wells, and known dual water source on some tracts, SPLP is re-contacting these owners to determine if the residence relies on the water wells as the "sole source" of water, or if the water well is for secondary non-consumptive use.

Despite these facts, SPLP's goal is to minimize any potential impacts to water supply wells. To that end, with the Departments approval, SPLP will utilize a blend of standard bentonite and Aquabloc as the drilling fluid blend for use during pilot hole progress. The Department has recognized Aquabloc as an approved drilling fluid, and SPLP would follow the manufacturers recommended application rate.

30. The Report discusses potential changes in water quality, but also needs to discuss potential changes to water quantity, as the potential exists for the HDD bore to adversely impact the yield of private water supply wells. Please describe how this will be done consistent with applicable provisions of the latest versions (February 6, 2018) of

the Inadvertent Return Assessment, Preparedness, Prevention and Contingency Plan, and the Operations Plan (January 2018).

It is unclear what the Department has requested in asking for a description as to "how this will be done" with respect to potential adverse effects to water supply well yields. SPLP assumes that the Department has requested a description of what actions SPLP intends to take to address any potential adverse effects on water quantity. To that end, SPLP notes that the drilling best management practices discussed in the Reevaluation report serve to reduce the risk of any potential adverse impacts to water quantity. Additionally, the use of Aquabloc in the pilot phase of the HDD should reduce the risk that HDD activities will create additional preferential pathways for groundwater that could cause groundwater to migrate away from the bore hole towards the recharge zone for each of these water supplies. In addition, both the Inadvertent Return Assessment, Preparedness, Prevention and Contingency Plan ("IR Plan") and the Operations Plan require SPLP to offer alternative water supplies to landowners with water supply wells within 450 ft of the drill profile. The best means to protect a water well during the HDD is non-use. Obviously, to the extent a landowner accepts this offer, their water supply should not be adversely affected during HDD activities. Moreover, even if the landowner does not accept an offer of alternative water supply, the IR Plan requires SPLP to address to the satisfaction of the landowner any complaints associated with water quantity during HDD activities. Finally, if a landowner identifies any impact to a private water supply attributable to pipeline construction after post-construction sampling, including impacts to yield, the IR Plan obligates SPLP to restore or replace the impacted water supply to the satisfaction of the private water supply owner.

SPLP submits that we have been, and are, in compliance with the terms and requirements of analysis of the Order, as agreed to by the Department, and that no further analysis is required for the Department to consent to the start of this HDD. SPLP therefore requests that the Department approve the Reevaluation Report for Valley Road Crossing (HDD S3-0591) as soon as possible.

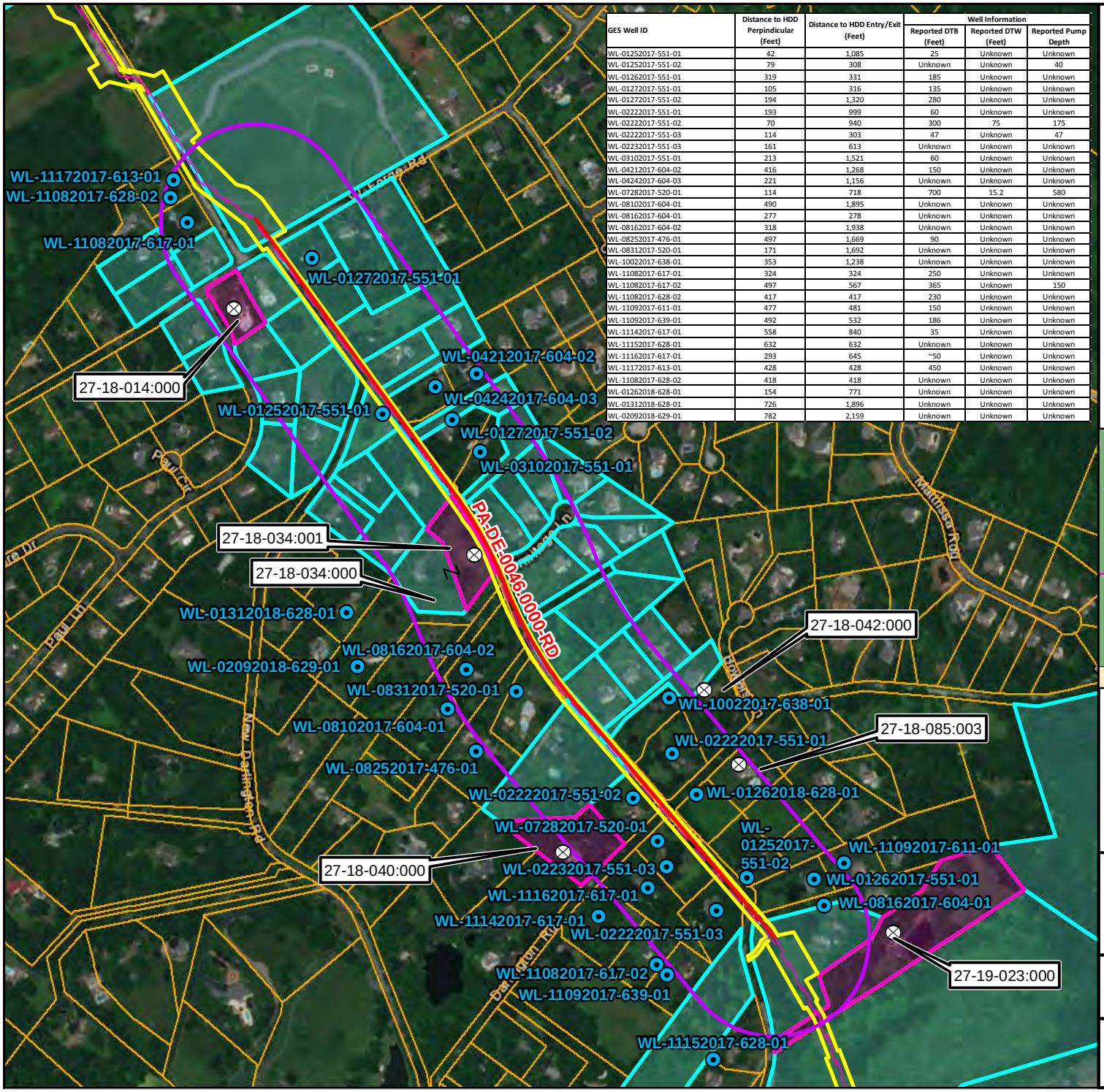
Sincerely,

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

Attachments:
1-Water Supply Illustration
2-Replacement Geotech Report Page
3-HDD Profiles with Fracture Trace and Well Data4-Water Well Testing Results

ATTACHMENT 1

WATER SUPPLY ILLUSTRATION



GES Well ID	Distance to HDD Perpindicular (Feet)	Distance to HDD Entry/Exit (Feet)	Well Information		
			Reported DTB (Feet)	Reported DTW (Feet)	Reported Pump Depth
WL-01252017-551-01	42	1,085	25	Unknown	Unknown
WL-01252017-551-02	79	308	Unknown	Unknown	40
WL-01262017-551-01	319	331	185	Unknown	Unknown
WL-01272017-551-01	105	316	135	Unknown	Unknown
WL-01272017-551-02	194	1,320	280	Unknown	Unknown
WL-02222017-551-01	193	999	60	Unknown	Unknown
WL-02222017-551-02	70	940	300	75	175
WL-02222017-551-03	114	303	47	Unknown	47
WL-02232017-551-03	161	613	Unknown	Unknown	Unknown
WL-03102017-551-01	213	1,521	60	Unknown	Unknown
WL-04212017-604-02	416	1,268	150	Unknown	Unknown
WL-04242017-604-03	221	1,156	Unknown	Unknown	Unknown
WL-07282017-520-01	114	718	700	15.2	580
WL-08102017-604-01	490	1,895	Unknown	Unknown	Unknown
WL-08162017-604-01	277	278	Unknown	Unknown	Unknown
WL-08162017-604-02	318	1,938	Unknown	Unknown	Unknown
WL-08252017-476-01	497	1,669	90	Unknown	Unknown
WL-08312017-520-01	171	1,692	Unknown	Unknown	Unknown
WL-10022017-638-01	353	1,238	Unknown	Unknown	Unknown
WL-11082017-617-01	324	324	250	Unknown	Unknown
WL-11082017-617-02	497	567	365	Unknown	150
WL-11082017-628-02	417	417	230	Unknown	Unknown
WL-11092017-611-01	477	481	150	Unknown	Unknown
WL-11092017-639-01	492	532	186	Unknown	Unknown
WL-11142017-617-01	558	840	35	Unknown	Unknown
WL-11152017-628-01	632	632	Unknown	Unknown	Unknown
WL-11162017-617-01	293	645	~50	Unknown	Unknown
WL-11172017-613-01	428	428	450	Unknown	Unknown
WL-11082017-628-02	418	418	Unknown	Unknown	Unknown
WL-01262018-628-01	154	771	Unknown	Unknown	Unknown
WL-01312018-628-01	726	1,896	Unknown	Unknown	Unknown
WL-02092018-629-01	782	2,159	Unknown	Unknown	Unknown

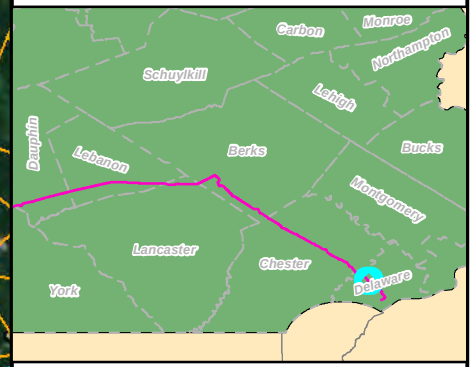
Legend

- LOD
- PPP Centerline
- Parcel
- HDD
- 450 foot buffer of HDD alignment
- Public Water Supply/Landowner Confirmed No Well
- Testing Refused

****Testing locations current as of 04/30/2018**

- GES Testing Location
- Known Well, Untested (Location Approximate)

Location



N

0 400 800

Feet

Well Location Map
HDD# PA-DE-0046.0000-RD
Delaware County, PA.

Prepared By: TETRA TECH

Date: 5/7/2018

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

Coordinate System: NAD 83 Stateplane, PA South, Feet

P:\GIS\projects\112C03958-PPP\MXD\WellLocations\WellLocation_PA_DE_0046_0000.mxd LN

ATTACHMENT 2

GEOTECHNICAL REPORT REPLACEMENT PAGE

BORING LOG NO. B6-2W Valley Rd/Darlington Rd West

PROJECT: Mariner East Pipeline Borings

CLIENT: Directional Project Support Incorporated
Magnolia, TX 77354

SITE: Spread 6

LOCATION PA-DE-0064.0000-RD
20170804-17
Latitude: 39.922642° Longitude: -75.465508°
Approximate Surface Elev: 355 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	RQD (%)	Core rate (min/ft)	Penetrometer Test (tsf)
Run 18, Similar, close to wide spacing, weathered zone 183.5 to 184.1 feet *(continued)*									
					117		92	4.5 3 3.5 2.5 2 2.5	
185.5	169.5+/-	185							
Run 19, Similar, highly fractured 190.5 to 195.5 feet, increased quartz bands 190.5 to 195.5 feet									
					118		83	2.5 2.5 3 3 3.5 3.5 3.5 3.5 3.5 3.5	
195.5	159.5+/-	190							
Run 20, Similar		195							
					84		100	3 3.5 4 3 3.5 2 5.5	
202.5	152.5+/-	200							
Boring Terminated at 202.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud rotary with wireline

Abandonment Method:
Grouted to surface

Notes:
Gneiss typically contained quartz, plagioclase, mica and hornblende
NR - Not recorded

WATER LEVEL OBSERVATIONS

▽ *29' AB*

Terracon
201 Hammer Mill Rd
Rocky Hill, CT

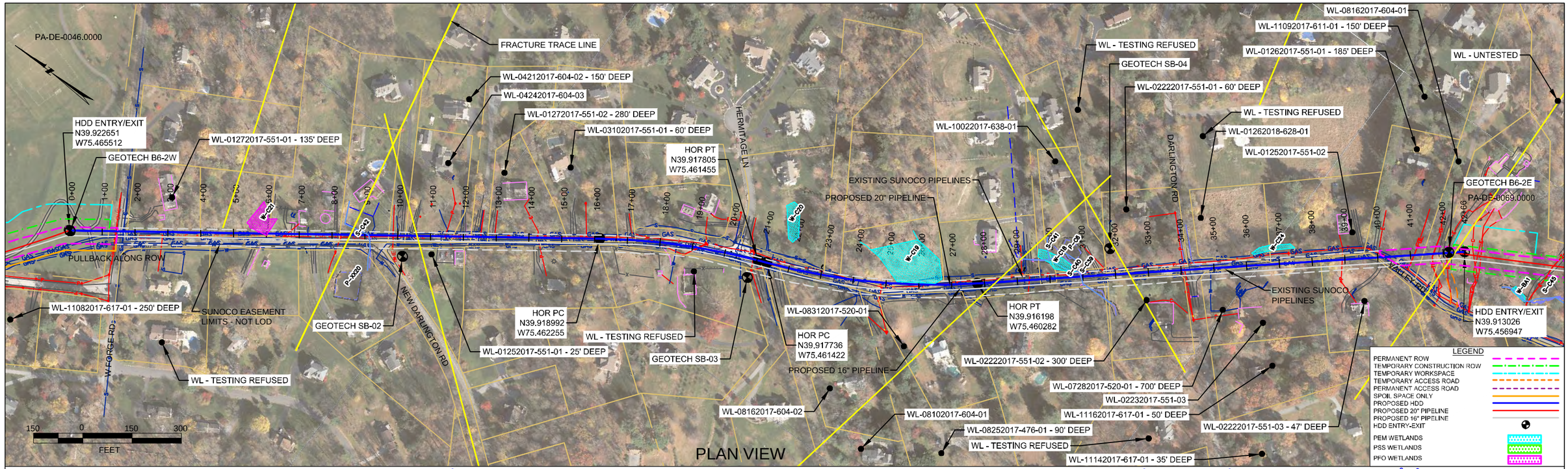
Boring Started: 08-17-2017 | Boring Completed: 08-24-2017

Drill Rig: CME-850XR | Driller: Terracon/Allen S.

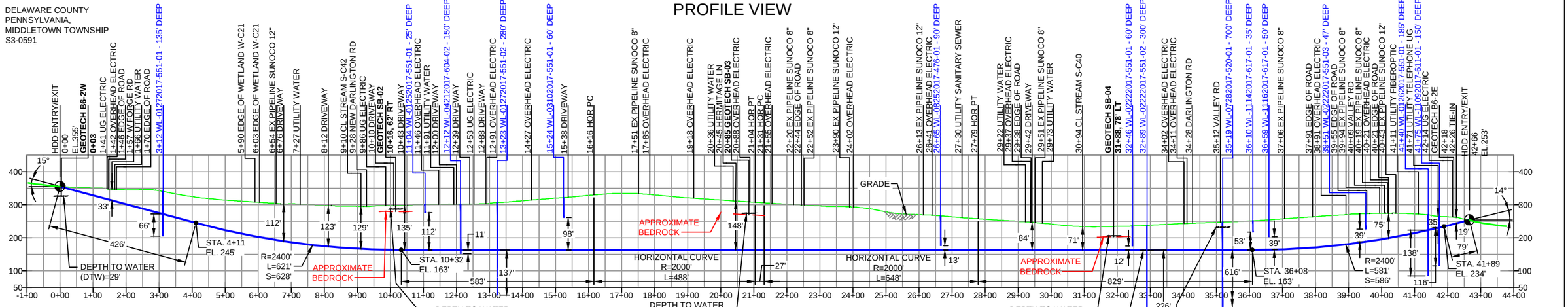
Project No.: J217P078 | Exhibit: A-1

ATTACHMENT 3

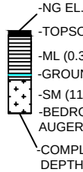
HDD PROFILES WITH WELL LOCATIONS, WATER LEVELS, AND FRACTURE TRACE LINES



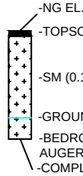
PROFILE VIEW



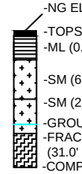
GEOTECH SB-02



GEOTECH SB-03



GEOTECH SB-04



NOTE: REFER TO TEST BORING LOG S3-0591 FOR COMPLETE SOIL MATERIAL DESCRIPTION

DESIGN AND CONSTRUCTION:

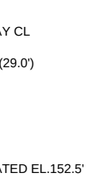
1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXISTING UTILITIES SHOWN OR NOT SHOWN ON THIS DRAWING.
2. THE MINIMUM SEPARATION DISTANCE FROM EXISTING SUBSURFACE UTILITIES SHALL NOT BE LESS THAN 10 FEET AS MEASURED FROM THE OUTSIDE EDGE OF THE UTILITY TO OUTSIDE OF PROPOSED PIPELINE.
3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=): 4266'
   HDD PIPE LENGTH (S=): 4294'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE OR ENGINEER APPROVED EQUAL)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
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. PIPELINE AND CROSSING TO BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH LAST APPROVED AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION SPECIFICATIONS FOR PIPELINES CONVEYING FLAMMABLE AND NON-FLAMMABLE SUBSTANCES.
13. BLASTING NOT PERMITTED.

FOR GEOLOGIC ANALYSIS ONLY

GEOTECH B6-2W

NOTE: REFER TO TEST BORING LOG B6-2W TERRACON PROJECT #J217P078 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH B6-2E



NOTE: REFER TO TEST BORING LOG B6-2E TERRACON PROJECT #J217P078 FOR COMPLETE SOIL MATERIAL DESCRIPTION

DELAWARE COUNTY
PENNSYLVANIA,
MIDDLETOWN TOWNSHIP
S3-0591

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-6.11	TO	ES-6.14	EROSION & SEDIMENT PLAN	
SHEET 7	TO	SHEET 9	AERIAL SITE PLAN	
DWG NO		DWG NO	DESCRIPTION	

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP5	ADDED FRACTURE TRACE LINE AND WELL DATA PER CLIENT REQUEST	MRS	05/21/18	RMB	05/21/18	AMC	05/21/18
EP4	UPDATED GEOTECH INFO PROVIDED BY DPS	MRS	11/15/17	RMB	11/15/17	AMC	11/15/17
EP3	INCREASED VERTICAL AND HORIZONTAL CURVE RADIUSES TO MATCH OZDD DESIGN	MRS	10/31/17	RMB	10/31/17	AMC	10/31/17
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	DLM	09/30/16	RMB	09/30/16	AAW	09/30/16
EP1	REVISED PER PADEP COMMENTS	MRS	05/18/16	RMB	05/18/16	AAW	05/18/16
EP		MRS	03/15/16	RMB	03/15/16	AAW	03/15/16

Sunoco Logistics Partners L.P.

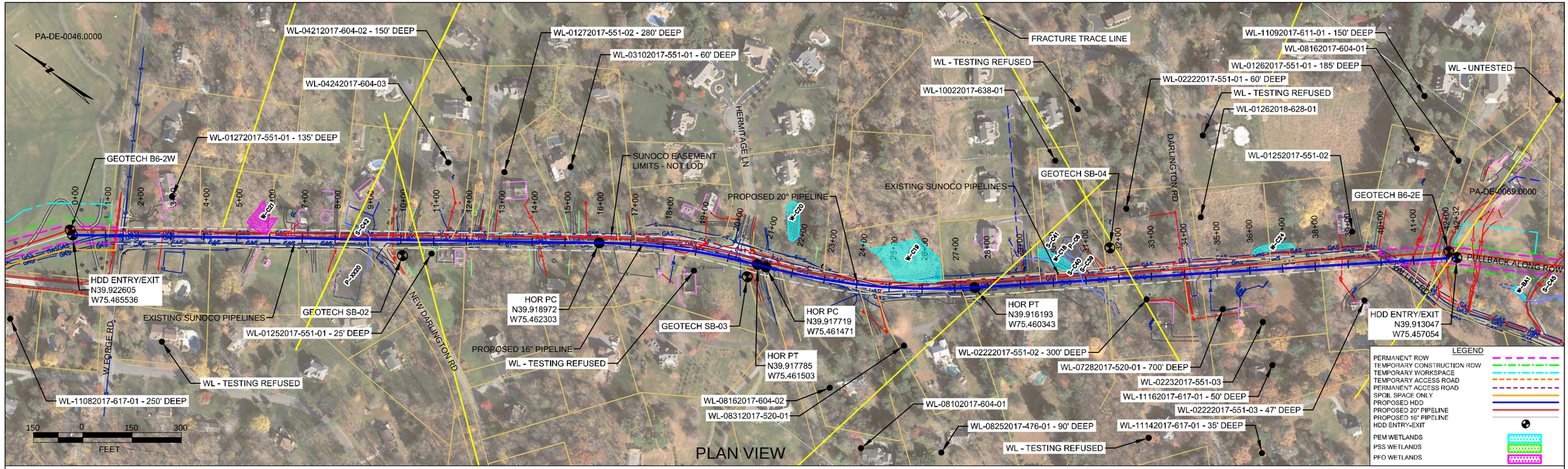
TETRA TECH ROONEY
(303) 792–5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
VALLEY ROAD / DARLINGTON RD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=300'

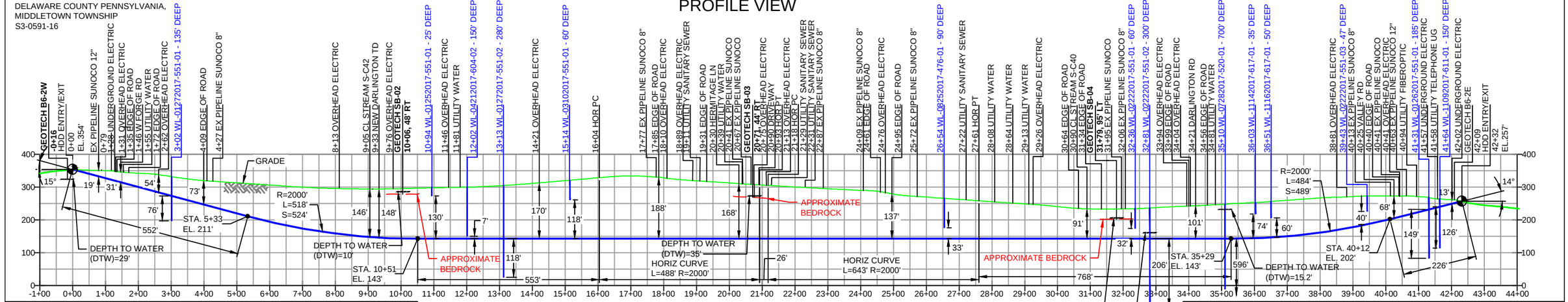
DWG. NUMBER: PA-DE-0046.0000-RD



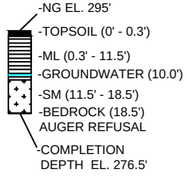
PLAN VIEW

DELAWARE COUNTY PENNSYLVANIA,
MIDDLETOWN TOWNSHIP
S3-0591-16

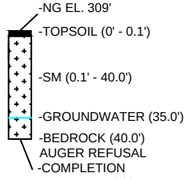
PROFILE VIEW



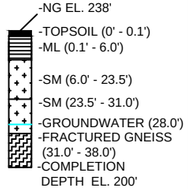
GEOTECH SB-02



GEOTECH SB-03



GEOTECH SB-04



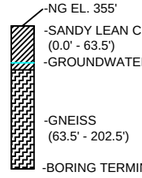
NOTE: REFER TO TEST BORING LOG S3-0591 FOR COMPLETE SOIL MATERIAL DESCRIPTION

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=): 4232'
   HDD PIPE LENGTH (S=): 4269'
   16" x 0.438" W.T., X-70, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 30-35 MIL ARO (POWERCRETE OR ENGINEER APPROVED EQUAL)
5. INTERNAL DESIGN PRESSURE 2100 PSIG (SEAM FACTOR 1.0, DESIGH FACTOR 0.50).
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 2625 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.
12. PIPELINE AND CROSSING TO BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH LAST APPROVED AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION SPECIFICATIONS FOR PIPELINES CONVEYING FLAMMABLE AND NON-FLAMMABLE SUBSTANCES.
13. BLASTING NOT PERMITTED.

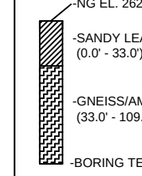
FOR GEOLOGIC ANALYSIS ONLY

GEOTECH B6-2W



NOTE: REFER TO TEST BORING LOG B6-2W TERRACON PROJECT #J217P078 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH B6-2E



NOTE: REFER TO TEST BORING LOG B6-2E TERRACON PROJECT #J217P078 FOR COMPLETE SOIL MATERIAL DESCRIPTION

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-6.11	TO	ES-6.14	EROSION & SEDIMENT PLAN
SHEET 7	TO	SHEET 9	AERIAL SITE PLAN
DWG NO		DWG NO	DESCRIPTION

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP6	ADDED FRACTURE TRACE LINE AND WELL DATA PER CLIENT REQUEST	MRS	05/21/18	RMB	05/21/18	AMC	05/21/18
EP5	UPDATED NOTE 5 AND 10 PER INCREASED 16" MOP	MRS	05/09/18	RMB	05/09/18	AMC	05/09/18
EP4	UPDATED GEOTECH INFO PROVIDED BY DPS	MRS	11/15/17	RMB	11/15/17	AMC	11/15/17
EP3	INCREASED VERTICAL AND HORIZONTAL CURVE RADIUSES TO MATCH OZDD DESIGN	MRS	10/31/17	RMB	10/31/17	AMC	10/31/17
EP2	REVISED PER PADEP COMMENTS RECEIVED 09-06-16	DLM	10/07/16	RMB	10/07/16	AAW	10/07/16
EP1	REVISED PER PADEP COMMENTS	MRS	05/20/16	RMB	05/20/16	AAW	05/20/16

Sunoco Logistics Partners L.P.

TETRA TECH ROONEY
(303) 792–5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
VALLEY ROAD / DARLINGTON RD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=300'

DWG. NO: PA-DE-0046.0000-RD-16