Bog Turtle (*Glyptemys muhlenbergii)* Conservation Plan

Pennsylvania Pipeline Project

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1.0 INTRODUCTION

On behalf of Sunoco Pipeline L.P. (SPLP), Tetra Tech, Inc. (Tetra Tech) has prepared this Bog Turtle (*Glyptemys muhlenbergii*) Conservation Plan for the Pennsylvania Pipeline Project (PPP or Project). This plan provides background information and presents the proposed conservation measures developed in coordination with the U.S Fish and Wildlife Service (USFWS or Service) Pennsylvania Ecological Services Field Office to minimize unavoidable impacts the Endangered Species Act-listed threatened bog turtle. This plan describes the Project, summarizes bog turtle survey results, and discusses avoidance and minimization measures that will be used to minimize impacts to bog turtles to insignificant and discountable levels.

1.1 PROJECT DESCRIPTION

SPLP proposes to construct and operate the PPP to expand existing pipeline systems and provide natural gas liquid (NGL) transportation of up to 350,000 barrels per day. The Project involves the phased installation of approximately 561 miles of two parallel pipelines within a 306-mile, 50-foot-wide right-of-way (ROW) from Houston, Washington County, Pennsylvania to SPLP's Twin Oaks facility in Delaware County, Pennsylvania with the purpose of interconnecting with existing SPLP Mariner East pipelines. Initially, a 20-inch diameter pipeline would be installed within the ROW from Houston, PA to the Twin Oaks facility (306 miles) and a second, up to 20-inch diameter pipeline, is proposed to be installed in the same ROW. The second line is proposed to be installed from SPLP's Delmont Station, Westmoreland County, Pennsylvania to the Twin Oaks facility, paralleling the initial line for approximately 255 miles. Although installation of the pipelines will be staggered to a small degree, they will be installed within the same construction sequence and same season. In addition to the pipeline facilities, some aboveground facilities such as block valves and pump stations will be required to complete the Project. A general Project location map and full Project description is provided in Appendix A. The Service has been provided updated Project ArcGIS shapefiles of Project areas and aquatic resources throughout the coordination process.

1.2 LAND REQUIREMENTS

The proposed Project would result in temporary access during the construction period of proposed facilities. Construction of the pipeline would require a 75-foot wide Right-of-Way (ROW) that would contain a 50-foot wide post-construction ROW that is permanently maintained and a 25-foot wide temporary workspace that would be used to facilitate the installation of the pipelines. Following installation, the 25-foot temporary workspace unit would be restored and allowed to return to its pre-construction state unless it is within an existing, permanently maintained ROW. Additional temporary work space (ATWS) would also be needed at some areas to facilitate construction. The sizes of these workspaces would depend on site-specific requirements. All workspaces would be clearly defined within Project mapping and within agency and municipality applications. Following construction, ATWS's would be restored and allowed to return their pre-construction state unless they are within an existing, permanently maintained ROW.

Construction of the Project's aboveground facilities and the use of non-public access roads would have land requirements. New pump stations would generally require 3-4 acres of land and modifications to existing pump stations would require 2-3 acres of additional land. Support sites, such as pipe/contractor yards, are to be sited on previously disturbed areas and generally range from 5-15 acres in size. Temporary use would primarily be limited to existing non-public roads, driveways, and farm lanes that may require improvements such as widening and reinforcing sections to accommodate large vehicles. Permanent access roads to stations or valve settings may also be required. All proposed temporary and permanent access roads would be clearly defined within Project mapping and within agency and municipality applications. Following construction, temporary work spaces would be restored and allowed to return their pre-construction state unless they are within an existing, permanently maintained ROW.

2.0 CONSERVATION PLAN

On behalf of SPLP, Tetra Tech contracted several Service-recognized bog turtle surveyors to complete Phase I surveys, and Phase II and Phase III surveys (if necessary) at all wetlands within and in the vicinity of all Project workspaces, including access roads and pump stations within the range of the bog turtle. The gathered background information and survey results provided the knowledge base for the implementation of pre-construction and construction avoidance planning.

2.1 FIELD SURVEYS

2.1.1 Agency Information

The bog turtle is documented as occurring at several sites within and adjacent to the Project area. Project-related coordination with the Service yielded information on known occupied bog turtle sites so early planning for avoidance and minimization could be considered. The Service provided a list of these sites in an email to Preston Smith of Tetra Tech dated April 21, 2014. These Service-identified wetlands, as well as wetlands where Project surveys confirmed species presence, are considered as 'occupied' bog turtle sites. In addition, after review of the initial iteration of this Bog Turtle Conservation Plan sent to the Service in October 2015, the Service outlined its determination in regard to bog turtles in a February 16, 2016 letter to Tetra Tech. In that letter, the Service provide concurrence with most of the survey findings and avoidance measures, but expressed the need for possible additional survey, information, and further avoidance and minimization. As a result, a second revision of the conservation plan was provided to the service in February 2016 and addressed the concerns of the February 16th correspondence. The February 2016 version was reviewed by the Service and a multi-agency field meeting was scheduled for April 6, 2016 to provide the Service with a better understanding of the avoidance and minimization measures taken to date. The Service provided further comment during the field meeting and this April 2016 conservation plan addresses those comments.

2.1.2 Survey Efforts

Wetlands delineations were completed along the Project area from November 2013 to January 2016. Results of these efforts were provided to bog turtle surveyors with the understanding that all wetlands without prior data (e.g., already known occupied) required Phase I evaluation with follow-on Phase II and Phase III surveys if necessary depending on the Phase I results. This evaluation was restricted to the eight counties (Cumberland, York, Dauphin (limited to the Swatara Creek Watershed), Lebanon, Lancaster, Berks, Chester, and Delaware) within the range of the bog turtle along the PPP alignment.

The investigations were conducted by numerous consultants, beginning with Phase I (habitat) surveys by Wildlife Specialists, LLC (bog turtle Surveyor: Stan Boder) in 2013. The majority of PPP bog turtle surveys were conducted in 2014, by a survey team of four sub-consultants; Aqua-Terra Environmental Ltd. (Aqua-Terra; bog turtle Surveyor: James Drasher), Environmental Consultation Services, Inc. (ECSI; bog turtle Surveyor: Kevin Keat), Jason Tesauro Consulting, LLC (Tesauro Consulting; bog turtle Surveyor: Jason Tesauro), and Skelly and Loy, Inc. (Skelly and Loy; bog turtle Surveyors: Ben Berra, Andy Brookens, and Logan Zugay). The 2014 surveys included Phase I habitat evaluations, Phase II presence/absence surveys and Phase III trapping surveys. A final round of surveys was conducted in 2015 and early 2016 by Aqua-Terra, Skelly & Loy, and Tesauro Consulting to investigate remaining wetlands that needed Phase I and/or Phase II surveys. During the various phases and years of the bog turtle survey process, reports were prepared and submitted to the Service. There were instances where a very small number of landowners restricted access for bog turtle field surveys. These wetlands are considered 'assumed' sites for the species, in accordance with Service recommendations.

2.1.3 Summary of Survey Findings

During the PPP field survey efforts, approximately 430 wetlands or complexes were investigated for suitable bog turtle habitat (Phase I) up through the end of August 2015. Of these wetlands, 98 were found to have the combination of soils, vegetation, and hydrology typical of habitat occupied by bog turtles (i.e., Phase I positive) and 332 were found not to have these appropriate habitat characteristics (i.e., Phase I negative). The Service agreed with the determinations for the 430 wetlands within their February 16th correspondence.

Species presence surveys (Phase II and Phase III) were initiated at 95 Phase I positive wetlands and three were inaccessible to perform the follow-on survey. Based on the results of these surveys, and the Project alignment at the time of the USFWS review, there are eight wetlands within the Project's limits of disturbance (LOD) and two wetlands within 300 feet of the LOD that are occupied or presumed occupied by bog turtles. These areas are referenced within the Services February 16th correspondence and present here in Table 1.

Table 1. Occupied and assumed presence wetlands that will be directly or indirectly affected by the action for project alignment prior to January 26, 2016 meeting.

Wetlands	BT Occupancy	Location
A54 (A53*)	Occupied	Within LOD
A55	Occupied	Within LOD
C6	Occupied	Within 300 feet
C7	Occupied	Within LOD
C8	Occupied	Within LOD
C36	Assumed Presence	Within 300 feet
C37	Assumed Presence	Within LOD
C43	Occupied	Within LOD
H1	Assumed Presence	Within LOD
C44	Occupied	Within LOD

*A53 is part of A54 (see Figure 1a). It is no longer referred to as wetland A53, just A54.

2.2 CONSERVATION MEASURES

SPLP has gone to great lengths to avoid and minimize direct and indirect impacts to bog turtles. The wetlands that are in the vicinity or traversed by the Project and presented in Table 1 represent an initial iteration of the least environmentally-damaging practicable alternative; the original alignments crossed or came in the vicinity of far more occupied wetlands. In particular, large reroutes around Marsh Creek State Park and the occupied wetlands at the Middle Creek Wildlife Management Area would have resulted in far greater impacts to this species. The initial overall Project alternative was presented to and evaluated by the Service who, in turn, provided further comment and recommendation. Those comments and further recommendations were discussed with the Service during a January 26, 2016 meeting and within the Service's February 16, 2016 correspondence. SPLP has taken those comments and correspondences seriously and this conservation plan moving forward represents a further reduction in potential impacts to this species. Additionally, on April 6, 2016 the Service, Pennsylvania Department of Environmental Protection (PADEP), Pennsylvania Fish and Boat Commission (PAFBC), and U.S. Army Corps of Engineers (USACE) field visited wetlands A54, A55, C6, C43, C38 and H1. Wetlands AM1, AM2, and AM3 were also visited as they are new wetlands identified during a reroute around bog turtle occupied Wetlands C7 and C8.

The following sections outline SPLP's pre-construction, construction, and post-construction avoidance, minimization, and conservation best management practice (BMP) commitments to minimize impacts to the bog turtle. These include, but are not limited to alternative Project siting and construction

methodology, on-site construction sequencing, pre-construction surveys, post construction monitoring, and post-construction habitat searches.

2.2.1 Pre-construction

General Minimization and Avoidance

From the onset of the Project, SPLP has instructed Project designers to consider environmental impacts in regard to all aspects of the proposed Project and to avoid and minimize sensitive resources wherever possible while allowing safe installation. Pipeline engineers were provided a list of restrictions, recommendations, and requirements to consider during the design phase. Major considerations were co-location with existing utility corridors, limiting the construction corridor to the minimum amount practicable, use of horizontal directional drill (HDD) technology, geo-technical testing, and avoidance and minimization at sensitive habitats.

During the development of the Project route, SPLP worked with routing agents and property owners to minimize and avoid impacts to forested uplands and wetlands, conservation easements, and other sensitive habitats where possible. SPLP also co-located the Project alignment with other similar disturbances wherever possible, and paralleled existing SPLP-maintained utility corridors for the majority of the route so that these existing maintained areas could be utilized as workspace for the PPP. SPLP has co-located the Project with a currently existing SPLP right-of-way (ROW) for approximately 80% of the Project. This is a significant means for avoiding new impacts to sensitive resources (i.e., forested wetlands, forest areas, streams) and for minimizing environmental impacts for the entire Project. SPLP has also co-located with foreign utility lines whenever possible when routing pulls away from the existing SPLP ROW. In addition, SPLP has implemented a number of route variations through environmental feedback, both minor and major, to further reduce the impacts associated with the Project. Many of these route variations are driven by environmental factors including wetland areas occupied by sensitive species such as bog turtles. One such reroute eliminated the need to cross the Marsh Creek wetland complex. A second reroute minimized the number of wetlands traversed by the Project in the vicinity of Middle Creek.

Due to the linear nature and length of the proposed Project and the abundance of wetland and stream resources in Pennsylvania, total avoidance of all wetland crossings was not possible or practicable. However, through substantial project planning (including route selection, design of workspaces, and selection of construction and restoration methods), SPLP has avoided and minimized impacts to wetlands to the maximum extent practicable.

As stated, an important factor for wetland impact minimization was SPLP's siting of the proposed PPP ROW to parallel and overlap an existing ROW for the majority of its course. This reduced impacts to undisturbed wetland resources, by restricting portions of the construction activities to a 50-foot-wide ROW and maintaining the permanent operational ROW at 50 feet. At almost all wetland and stream crossings the construction ROW has been reduced to 50-feet wide. This is the minimum width needed to safely install the two pipelines. ATWS, permanent access roads, and permanent fills have been located outside wetland areas to further reduce long term impacts to wetlands.

Outside of routing alternatives there are construction methodologies and best management practices (BMPs) that can be implemented to reduce impacts to sensitive resources, including wetlands and streams. One of those construction alternatives implemented by SPLP to avoid and minimize environmental impacts, is the HDD method at areas of unique sensitivity (i.e., bog turtle habitat, rare plant populations, large rivers or reservoirs, forested wetlands, and cultural resource sites). Without HDD, typical construction methods through these areas would involve conventional pipeline trenching (i.e., open cut trenching) construction methods, resulting in significant temporary and permanent cover type conversion impacts. Specifically, conventional construction throughout the entire Project length would have required clearing, grading, and the excavation and disturbance of approximately 100 acres of wetlands and approximately 87,000 feet of stream crossings (linear length of stream in construction

ROW). In comparison, with the currently proposed locations of HDD construction, impacts have been reduced to approximately 39 acres of wetlands and approximately 52,800 feet of stream crossings.

The HDD method is considered to be a great construction method alternative for bog turtle habitats after reroute alternatives had been exhausted. Surface impacts to bog turtle wetlands traversed by the current alignment will be eliminated using successful HDD methods. The primary potential environmental impact associated with HDD involves the unintended release of drilling fluids, known as inadvertent return. Drilling fluids comprise mainly freshwater and bentonite clay and are referred to as drilling mud. If an inadvertent return occurs at the location of a wetland, it can result in the discharge of varying amounts of drilling mud into the resource. While the potential for inadvertent returns cannot be eliminated, SPLP conducted geotechnical drilling studies in the vicinity of the Project (Appendix B). This information was utilized in the case-by-case design of the HDD profile for each site by directing drill locations and depths to layers of stable materials to reduce the potential for inadvertent returns throughout the Project area. Cohesive soils, such as clays, dense sands, and competent rock are considered ideal materials for containment of drilling mud. In non-cohesive soils, such as gravel, a greater depth of cover is required.

Erosion and sedimentation controls will be installed and maintained in accordance with Pennsylvania's Erosion and Sediment Control Regulations and PADEP's Erosion and Sediment Control Best Management Practice Manual to minimize direct and indirect impacts on wetlands and streams. These controls, procedures, and BMPs are emulated within the Project's Erosion and Sedimentation Control Plan, which will receive full PADEP and County Conservation Department review and approvals. In addition, SPLP has developed a stand-alone Inadvertent Return Contingency Plan that outlines the pre-construction and construction procedures for reducing the risk of inadvertent returns, as well as the procedures for inspecting, reporting, containing, and restoring discovered returns.

Bog Turtle Occupied Wetlands

After all reroutes and avoidance measures were implemented, the assumed/occupied bog turtle wetlands/complexes within 300 feet of the Project are presented in Table 2. The Project will cross underneath with the HDD or dry-bore method at four (A55, A54, C6, and C43), open trench one (AM2), and be within 300 feet of five (C7, C8, C44, AM2, AM3) occupied wetlands (Table 2). It is expected with a negative Phase II survey at Wetland C43 scheduled for the Spring of 2016, that the "Occupied" status of that wetland will be removed.

Figure 1a-d represents the current plans in these areas. Work areas found within 300 feet of C7, C8, AM1, AM2, and C44 will have bog turtle exclusion fencing placed between the wetland and construction area and a Qualified Bog Turtle Surveyor (QBTS) present for monitoring during construction when it occurs during the active bog turtle season.

11/12/16 Project Note: Per USFWS October 31, 2016 Correspondence C43 no longer is considered to be occupied habitat.

Table 2. Occupied and assumed presence wetlands that will be directly or indirectly affected by the action for project alignment after the April 6, 2016 meeting.

Wetland	BT Occupancy	Location	Crossing Method	BMP Summary
A54	Occupied	Within LOD	HDD	active season[2] drilling only, access and work area exclusion fencing and monitoring, implement inadvertent return plan
A55	Occupied	Within LOD	HDD	active season[2] drilling only, access and work area exclusion fencing and monitoring, implement inadvertent return plan
C6	Occupied	Within LOD	Dry-Bore	active season[2] access and work area exclusion fencing and monitoring
AM2[1]	Occupied	Within LOD	Open-trench	active season[2] access and work area exclusion fencing and monitoring
AM1/AM3[1]	Occupied	Within 300 ft	NA	active season[2] access and work area exclusion fencing and monitoring
C7	Occupied	Within 300 ft	NA	active season[2] access and work area exclusion fencing and monitoring
C8	Occupied	Within 300 ft	NA	active season[2] access and work area exclusion fencing and monitoring
C43	Occupied (Scheduled for Phase II Spring of 2016)	Within LOD	HDD	active season[2] drilling only, access and work area exclusion fencing and monitoring, implement inadvertent return plan
C44 .	Occupied	Within 300 ft	NA	active season[2] access and work area exclusion fencing and monitoring

[1]Small Phase 1 positive wetlands in the vicinity of known occupied wetlands C7, C8, and C6.
[2]Active Season = April 1 to September 30

The changes to the alternative that have occurred since the Service's original review are summarized here, organized by the general vicinity of the wetlands:

A54/A55 – this area has been exhaustively evaluated for alternatives to avoid impacts to these wetlands. The agricultural conservation easements in this area have constrained the effort and has forced SPLP to parallel their existing 8-inch line in this area. However, as an alternative to reduce the overall number of HDDs and construction activity in this area, the initially-proposed two separate drills of the pipes under A54 and A55 has been consolidated to a single drill. This will allow the pipes to be deeper along a greater length when crossing underneath these wetlands and reduces the number of entry and exit holes. This change has even further reduced the potential for inadvertent returns outside of what has already been incorporated into the design (i.e., geotechnical evaluation). Also the workspace and access between these two sensitive areas will be off-limits to construction activity/disturbance and would only be utilized in case of an emergency. This greatly reduces the activity in this area and further reduces the potential for impacts.

The Service and the PADEP requested steeper entry and exit drilling angles for HDD at these wetlands to enter bedrock prior to advancing the drill beneath the wetlands. SPLP has redesigned the entry and exit points to address this request and increased entry and exit angles from 10° to 12° for the 16-inch dimeter pipe HDD and at one of the drill angles for the 20-inch pipe HDD at these wetlands. Both HDDs will be in bedrock prior to drilling beneath the wetland (Appendix B). Updated profile drawings

are provided in Appendix C. The drill would enter/exit 250 feet from the edge of the western-most boundary of wetland A55. The drill would pass 25 feet under the western-most boundary of wetland A55 and 60 feet under the eastern-most boundary. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The substrate that will be passed through for the entirety of this wetland is known to be bedrock. The drill would continue beneath the western-most boundary of wetland A54 and would enter/exit 125 feet from the eastern-most edge of wetland A54. The drill would pass 60 feet under the western-most boundary of wetland A54 and 20 feet under the eastern-most boundary. Using the results of the geotechnical investigation (Appendix B), as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The substrate that will be passed through is for the entirety of this wetland is known to be bedrock. Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable. Figure 1A in Appendix D depicts the revised action in this area and the HDD drawing is provided in Appendix C.

The Service requested a series of piezometers be installed within Wetlands A54 and A55 to monitor groundwater conditions before, during, and after the HDD takes place. SPLP has committed to placing piezometers within these wetlands as requested. A detailed plan will be submitted to the Service for review prior to installation that will include proposed well locations, installation methodology, frequency of water level readings, and reporting methodology. The number of wells and frequency of water level readings will be sufficient to characterize the groundwater levels within the wetlands. SPLP will work with a QBTS to ensure installation and monitoring does not affect the species or alter habitat within these wetlands. Preconstruction groundwater monitoring will begin with installation of the piezometers within 2 weeks of receipt of USFWS approval of the plan and continue through construction and for 1-year following successful installation of the pipelines under these wetlands.

This area will be subjected to implementing all during construction BMPs, monitoring, and the HDD timing restriction as outlined in Section 2.2.2.

C6, C7, C8 – SPLP has rerouted the Project in this area to remove the planned HDD and no longer are traversing occupied wetlands C7 or C8 with the Project. Wetland C6 was found to be unavoidable, but would be crossed with a conventional “dry” bore and this method does not use drilling fluid to facilitate the crossing. There will be no surface disturbance to C6. Figure 1B in Appendix D depicts the revised action in this area. The bore drawing is provided in Appendix C. Should this action take place during the inactive season, no bog turtle special provisions or BMPs will be necessary. This area will be subjected to implementing all during construction BMPs and monitoring as outlined in Section 2.2.2.

AM2/AM1/AM3 – Wetland AM2 was found to be Phase 1 positive with minimal core habitat, however is in the vicinity of occupied Wetlands C7, C8, and C6. During the field view on April 6, 2016 the Service approved an open trench method to be used at AM2 with special protection exclusion measures and monitoring of this area by a QBTS. This will also protect wetlands AM1 and AM3 that occur in the vicinity of AM2, but will not be impacted by the project work areas. Figure 1B in Appendix D depicts the action in this area. Should this action take place during the inactive season, no bog turtle special provisions or BMPs will be necessary. This area will be subjected to implementing all during-construction BMPs and monitoring as outlined in Section 2.2.2.

C44 – SPLP has now routed the Project around this wetland. This wetland has been historically disturbed, due to agricultural practices and surrounding developments within its drainage basin, and has approximately 0.5 acre of designate survey area (DSA). A Phase II survey was conducted in 2014, and that effort is consistent with the 4-6 man-hours/acre of DSA listed in the survey protocol. It should also be noted that Skelly and Loy surveyed this wetland in 2003 as part of an unrelated development (known as Brookside), and did not find any bog turtles in C44. Additionally, since the DSA associated with C44 is not greater than 2 acres, per the draft Phase III Trapping Survey protocols, a Phase III survey is not warranted. Given that this wetland is now being avoided by direct disturbance, has been

Phase II surveyed twice, and does not meet the criteria for a Phase III, a Phase III survey is not warranted. Figure 1C in Appendix D depicts the revised action in this area.

As a precaution, this area will be subjected to implementing all during-construction BMPs and monitoring as outlined in Section 2.2.2.

C43 – This area has been exhaustively evaluated for alternatives to avoid traversing this wetland. After further evaluation of this wetland by Skelly and Loy, there is limited suitable habitat (less than .2 acre), is of low quality, and occurs in the existing maintained ROW. This area is immediately adjacent to Upper Uwchlan's Hickory Park and the wetland does exhibit some anthropogenic impacts due to the development of the park. This includes impacts from stormwater and pedestrian traffic in the wetland from a trail system that includes gabion baskets, culverts, and foot-bridges. This wetland was provided to SPLP/Tetra Tech as occupied by the Service, due to proximity of a known location. SPLP had requested the Service re-evaluate this wetland as an occupied location and conduct a site visit to facilitate the evaluation. Figure 1D in Appendix D depicts this area. Upon the Service's re-evaluation of the site, it was determined that a negative Phase II survey would remove the occupied status of this site and that no special drilling provisions would be necessary, except at the work spaces northwest of Park Road where special BMP's would be installed if drilling commences during the active season. Phase II surveys will begin in mid-April 2016 and end in mid-May 2016. Survey results will be submitted to the Service upon completion of the surveys. The HDD drawing is provided in Appendix C.

H1 – In an email from Brian Scofield of the Service dated April 7, 2016, the Service indicated that previous Phase 2 and 3 surveys at H1 were negative and confirmed that no special bog turtle considerations will be required at this HDD.

C36 and C37 - The Service during the April 6, 2016 field visit concurred with the Phase I negative assessment provided in the revised conservation plan at previously assumed presence wetlands C36 and C37. The Service also reiterated their concurrence in an email from Brian Scofield on April 7. No special bog turtle consideration will be required at this HDD.

Bog Turtle Phase II Negative with Potential Hydrological Connections Wetlands Planning

In its February 16, 2016 letter, the USFWS indicated that bog turtles usually occur in small, discrete populations occupying suitable wetland habitat dispersed along a watershed. The USFWS explained a concern for those wetlands that possess suitable habitat being directly impacted by the Project as possibly harboring bog turtles due to hydrological connections with occupied habitats. Those Project wetlands are listed and discussed below as C16, H14/H13, A52, A56, B19/B20, and C38/C40. Although Phase II bog turtle surveys conducted in 2014 and 2015 failed to detect the species in these wetlands, the Service indicated that the Phase II survey protocol is usually adequate to determine species presence or probable absence, but given the quality and quantity of habitat and its location in a watershed of known occurrences, a single Phase II survey is not adequate to confirm absence of the species. The Service requested more information on these wetlands, including a possible need to perform a site visit in a January 26, 2016 meeting and within the February 16, 2016 correspondence. As a result, Skelly and Loy evaluated the hydrological connections and provided more background on the quality and quantity of the suitable habitat and Phase II surveys in the discussions below.

C16 – This wetland contains two small headwater seeps that flow through the wetland from west to east, and exit the wetland along its northeastern limits (Appendix E: Figure 2A). From there the hydrology is concentrated into stream-C35 for a short distance (less than 50 feet) prior to its confluence with an on-stream pond (Pond-C5) located north and east of C16. Hydrology associated with Pond-C5 ultimately drains to the east via an unmapped watercourse towards Hopeland Road (and paralleling the existing 8-inch pipeline maintained areas approximately 500 feet to the north). After this unmapped and unnamed watercourse crosses Hopeland Road, it continues to flow east/northeast for approximately 500 feet until it drains into another man-made impoundment (unmapped) that is located approximately 1,000 feet north of the existing ROW and wetlands H13 and H14. This hydrology appears to then become part of a diffuse drainage system associated with a wetland complex (offsite

portions of H13/H14), all of which is located on the main stem of Middle Creek (S-C85/C86), just north of the Middle Creek Reservoir.

This wetland is a small complex located on a hillside (less than favorable landscape position for bog turtles) with a very small DSA. A Phase II survey was conducted in 2014 by Jay Drasher, and the effort associated with this survey exceeded the 4-6 man-hours/acre of DSA listed in the survey protocol. The quality and size of this wetland, along with the supporting Phase II survey, does not warrant additional study. The Service concurred with this assessment during the April 6, 2016 field meeting and accepts the Phase II negative surveys previously completed as the final determination.

H14/H13 – These wetlands contain headwater seep hydrology that flows in diffuse drainage patterns and well defined watercourses (S-C85/C86) in a generally southern direction towards Middle Creek Reservoir (Appendix E: Figure 2B). The hydroperiod associated with the seeps in H14 have been observed to be only seasonal, and the hydroperiod in H13 has been noted to be similarly seasonal (and only slightly more productive). In 2014, through observation made during multiple field visits, both wetlands were described as lacking a constant supply of cool groundwater, and exhibited strong hydrological fluctuations due to rain events. Hydrologic contributions upstream of H14/H13 include wetlands, man-made impoundments, and Middle Creek. The hydrology associated with H14/H13 flows in a southern direction and ultimately contributes to the Middle Creek Reservoir (located approximately 2,300 south of the existing 8-inch ROW). The Middle Creek basin's hydrologic characteristics in proximity to the PPP have been significantly altered as a result of the Pennsylvania Game Commission's (PGC) waterfowl management activities (including impoundments, roadways, ditching, etc.).

Access to these wetlands was not authorized in 2016 due to PGC waterfowl management activities, but valid Phase II surveys were conducted in 2014 by Jay Drasher, and the effort associated with these surveys exceeded the 4-6 man-hours/acre of DSA listed in the survey protocol. Mr. Drasher noted that these wetlands were marginal in regards to hydrology, and even suspended surveys in H14 due to unsuitable conditions. The DSA is not greater than 2 acres. The quality and size of the DSA at these wetlands, along with the supporting Phase II survey, does not warrant additional study. The Service concurred with this assessment during the April 6, 2016 field meeting and accepts the Phase II negative surveys previously completed as the final determination.

A52 – This wetland has been significantly modified as part of agricultural activities over the years and its hydrologic characteristics have not been unaffected. The majority of this wetland appears to have been drained by a series of channelized drainage ditches, some of which have been developed or improved recently. Hydrologic contributions upslope of this wetland include additional modified drainages. A52 in proximity to the PPP includes three main drainage areas, all of which have been altered/ditched, one of which also includes a man-made pond (Appendix E: Figure 2B). The ditches in A52 combine into one main channel (S-A76) that flows from north to south through the wetland. Since the ditches associated with A52 have been excavated or have downcut over the years to significant depths (2 to 4 feet), the shallow groundwater table in this wetland complex appears to have become depressed as well. Very limited suitable bog turtle habitat remains in this degraded wetland complex due to the hydrologic alterations and the limited amount of groundwater seeps that remain. The drainage through A52 flows in a generally southern direction, and downslope of the PPP concentrates to form a single watercourse (sans wetland) that is an unnamed tributary to large wetland complexes associated with Cocalico Creek and Blue Lake (approximately 3,000 feet south of the PPP). A52 has no direct hydrologic connections with other PPP wetlands located to the west (A54) or east (A56).
This wetland has been disturbed due to agricultural practices and has a very small DSA. A Phase II survey was conducted in 2014 by Drasher, and the effort associated with this survey far exceeded the 4-6 man-hours/acre of DSA listed in the survey protocol. Given the quality of the hydrologic connections, the quality and size of the DSA at this wetland, and the supporting negative Phase II survey, additional study is not warranted. The Service concurred with this assessment during the April 6, 2016 field meeting and accepts the Phase II negative survey previously completed as the final determination.

A56 – This wetland has been modified as part of agricultural activities over the years and its hydrologic characteristics have not been unaffected. Hydrologic contributions upslope of this wetland include additional agriculturally modified drainages. A56 in proximity to the PPP includes one main drainage channel (S-A87) as well as a man-made pond (Appendix E: Figure 2B). Limited perennial groundwater seeps are located on the western side of S-A87, and contribute to the base-flow of the channel. Suitable bog turtle habitat is limited in this degraded wetland complex due to the hydrologic alterations and the reduced amount of perennial groundwater seeps that remain. The primary habitat area is associated with a seep area that appears to have been historically ditched, but not maintained. The drainage through A56 flows in a generally southern direction, and downslope of the PPP concentrates to form a single watercourse (sans wetland) that is an unnamed tributary to Blue Lake (Cocalico Creek Drainage) approximately 3,000 feet south of the PPP. A56 has no direct hydrologic connections with other PPP wetlands located to the west (A54 and A52) or east.
This wetland has been disturbed due to agricultural practices and has an approximate DSA of 0.65 acre. A Phase II survey was conducted in 2014 by Drasher, and the effort associated with this survey far exceeds the 4-6 man-hours/acre of DSA listed in the survey protocol. Given the quality of the hydrologic connections, the quality and size of the DSA at this wetland, and the supporting negative Phase II survey, additional study is not warranted. The Service concurred with this assessment during the April 6, 2016 field meeting and accepts the Phase II negative survey previously completed as the final determination.

B19/B20 – Hydrology in wetland B19/B20 consists of a few small seeps with hydroperiods that may not be persistent year-round. The upslope drainages to B19/B20 are primarily wooded, and the general flow of hydrology through these wetlands is west to east. One primary channel (S-B18) and two other channels (S-B19 and S-B20) flow in an easterly direction through the wetland B19/B20 complex (Appendix E: Figure 2C). The primary channel (S-B18) ultimately flows under the Pennsylvania Turnpike (I-76) and confluences with Marsh Creek approximately 1,200 feet east of the PPP. It should be noted that the unnamed channel (S-B18) connecting B19/B20 to Marsh Creek must flow under Fairview road and the Pennsylvania Turnpike prior to confluencing with Marsh Creek.

These wetlands contain less than ideal potential bog turtle habitat (hillside landscape position, marginal vegetation, etc.) and less than 1 acre of DSA. A Phase II survey was conducted in 2014 by Drasher, and the effort associated with this survey is consistent with the 4-6 man-hours/acre of DSA listed in the survey protocol. Given the quality of the hydrologic connections, the quality and size of the DSA at this wetland, and the supporting negative Phase II survey, additional study is not warranted. The Service concurred with this assessment during the April 6, 2016 field meeting and accepts the Phase II negative survey previously completed as the final determination.

C38/C40 – These wetlands are associated with seeps and springs, and flashy, eroded watercourses. Wetlands C38 and C40 are hydrologically connected downslope of the PPP via offsite wetland habitat, and watercourses S-C72 (drains through W-C38) and S-C73 (drains through W-C40) (Appendix E: Figure 2D). Upslope of the PPP and the adjacent Pennsylvania Turnpike, the drainage basin to C38 consists of a highly developed residential subdivision and agricultural lands. The drainage basin upslope of the Pennsylvania Turnpike associated with C40 consists of the delineated W-Q79 and its associated watercourses (S-Q88 and Q87). Perennial watercourse Q88 (Black Horse Creek) is the same watercourse identified as C73 on the south side of the Pennsylvania Turnpike. The Black Horse Creek drainage basin contains a wooded riparian area surrounded by highly developed areas of residential communities. Although there are perennial seeps and springs associated with wetlands C38 and C40, the watercourses associated with these wetlands are incised 2 to 3 feet and have promoted the drainage and depression of the shallow groundwater table (and subsequently reducing potential bog turtle habitat supported by perennial spring/seep hydrology). Watercourses C73 (Black Horse Creek) and C72 drain in a south/southwestern direction through C38/C40 and confluence just north of the bridge carrying Little Conestoga Road over Black Horse Creek (located approximately 730 feet from the PPP). Downstream of Little Conestoga Road, Black Horse Creek drains into a finger of Marsh Creek Lake.

These wetlands contain about 1.5 acres of DSA, most of which is, "suboptimal for bog turtles", per Jay Drasher's Phase II evaluation. A Phase II survey was conducted in 2014 by Drasher, and the effort associated with this survey is consistent with the 4-6 man-hours/acre of DSA listed in the survey protocol. Given the quality of the hydrologic connections, the quality and size of the DSA at this wetland, and the supporting negative Phase II survey, additional study is not warranted. The Service concurred with this assessment having viewed the wetlands during the April 6, 2016 field meeting and accepts the Phase II negative survey previously completed as the final determination.

Training

Environmental training will be required for all personnel working in the ROW. Training will include a section on wildlife protection focusing on sensitive species such as the bog turtle. Training will involve the identification of the LOD, specific construction requirements, and any timing restrictions placed on HDD activities at bog turtle wetlands.

2.2.2 Construction

A QBTS will be on site during all construction activities occurring across or in the vicinity of bog turtle wetlands listed in Table 2. Those bog turtle wetlands that will be monitored are listed in Table 2 and include A54 (HDD), A55 (HDD), C6 (dry-bore), C7 (adjacent wetland), C8 (adjacent wetland), AM2 (open cut), C44 (adjacent wetland), and C43 (HDD). The QBTS's responsibility will be to monitor the pre-construction, construction, and restoration activities to ensure that this conservation plan is being implemented to its fullest extent and that work areas are not being exceeded and Project plans are being carried out. The QBTS will also ensure that construction personnel are trained and that the proper bog turtle BMPs are implemented, maintained, and removed as necessary upon completion of the work in those areas. Depending on the timing and spacing of these activities, multiple QBTSs may be utilized to ensure all activities can be completed efficiently.

The QBTS will inspect the surveyed (e.g. staked) LODs and marked access roadways prior to disturbance to ensure that they match Project plans. The QBTS may need to clear vegetation by hand to a height of 4 inches in some areas prior the start of construction to allow for effective monitoring. Surveys for bog turtles will occur prior to commencing any work related activities including the installation of protective silt fencing. Daily surveys will be conducted in each active work space prior to construction each day.

The boundaries of bog turtle habitat in close proximity to work areas will be temporarily marked to ensure that no activities are unintentionally conducted within bog turtle wetlands. Vertical curbing made of silt fence (minimum 10 inches in height) will be installed along the entire wetland/upland boundary in work areas adjacent to bog turtle wetlands to prevent stormwater from flowing from work areas into the main wetland and to prevent bog turtles from accessing the proposed work spaces. The interior and exterior of these barriers will be kept free of vegetation and will be monitored daily. This silt fencing will also be used to "wall-off" any upland areas in the vicinity of bog turtle wetlands to further prevent bog turtles from entering project workspaces. The fencing locations, installation, maintenance, and cleanup will be closely monitored by the QBTS.

To protect water quality, stringent soil and water protection measures will be required and implemented during construction. In addition, when revegetating and stabilizing soils, an appropriate seed mix will be used to avoid the propagation of invasive and exotic plant species. These commitments will be emulated within the Projects Erosion and Sedimentation Control and Pollution and Prevention plans that will receive state and county approvals. These erosion control measures will also remain after construction is complete and will be monitored until the Projects area is sufficiently vegetated. The QBTS will inspect the areas of these BMPs for bog turtles prior to final clean-up.

The primary minimization measure that SPLP will implement is the HDD, which is designed to eliminate surface disturbance to bog turtle wetlands. Two HDDs are planned that involve bog turtle wetlands:

the first HDD crosses underneath both A54 and A55 (Appendix D; Figure 1A), and the second crosses C43 (Appendix D; Figure 1D). Both HDDs involve the installation of two pipelines and will occur in the same construction season. No other bog turtle wetlands occur in the vicinity of these HDDs.

To further lend protection to this species, a seasonal restriction on HDDs at bog turtle wetlands will be imposed. As mentioned previously, the primary potential environmental impact associated with HDD involves inadvertent returns. A potential risk of an inadvertent return occurring in a bog turtle wetland is a hibernating turtle being forced from its hibernacula into winter elements. Therefore, SPLP will conduct HDDs at bog turtle wetlands only during their active season between April 1 and September 30. This will prevent the incidental direct take of hibernating bog turtles. If the Phase II survey at Wetland C43 is negative, then the seasonal restriction, as well as other special bog turtle considerations, will be removed from the HDDs underneath that wetland.

Should an inadvertent return occur, SPLP has developed a bog turtle-specific contingency plan (Appendix F). This plan outlines procedures to be implemented to avoid potential impacts to the bog turtle at the relevant HDD locations. A listing of HDD sites is provided in Attachment C of that plan with the special bog turtle HDDs highlighted. Construction personnel will be provided detailed construction plans for each HDD and will be required to implement all erosion and sedimentation control measures in this contingency plan.

2.2.3 Post-construction

Post-construction measures include restoring and stabilizing uplands in proximity to bog turtle wetlands. Disturbed soils in adjacent uplands will be stabilized and restored per the Erosion and Sedimentation Control and Pollution and Prevention Plans. Post-construction monitoring of these areas will be conducted to ensure that proper revegetation of native plant species occurs. SPLP does not anticipate any potential impacts to occupied bog turtle habitat and does not anticipate the need for restoration actions within any of the Table 2 listed bog turtle wetlands.

After the completion of construction activities, one post-construction survey will be conducted by a Service-recognized bog turtle surveyor to monitor the identified populations. The post-construction site visit will document completed Project activities in the vicinity of the identified populations and follow Phase II survey protocols. A brief letter report summarizing the results of the post-construction monitoring will be submitted to the Service.

“No mowing” signs will be placed along the boundary of the in-ROW bog turtle wetlands A54 and A55 and prevent mowing within the wetland during post-construction routine pipeline ROW operation and maintenance activities. Additional signs will be placed at the edge of Zone 2 (300 feet from the edge of the wetland) to demarcate the limit of herbicide application within the ROW. Hand clearing within the Zone 2 areas will only occur between October 1 and March 31 to avoid impacts to individual bog turtles.

3.0 CONCLUSION

This bog turtle Conservation Plan for the Pennsylvania Pipeline Project provides SPLP's commitment to avoidance, minimization, and conservation measures to prevent impacts to the bog turtle within the Project area. SPLP has conducted extensive background research and field surveys to identify bog turtle occurrence and habitats within and adjacent to all Project work areas. These surveys along with direct coordination with the USFWS Pennsylvania Ecological Services Field Office provided the foundation for the development of this plan.

SPLP's efforts from Project inception to presentation of this plan to route the Project around occupied or assumed occupied sites and minimize impacts to the bog turtle is well documented. SPLP has avoided highly sensitive occupied areas at Marsh Creek State Park and Middle Creek Wildlife Management Area and as rerouted around other occupied wetlands such as C7, C8, and C44. As a standard practice for avoiding impacts to the bog turtle when avoidance measures have been considered SPLP will cross three known occupied (A54, A55, C43) bog turtle wetlands utilizing HDD technology during the turtle's active period (April 1 to September 30). SPLP has rerouted around occupied wetlands C7 and C8, but will need to dry-bore Wetland C6 in this area. A Phase II survey scheduled to be completed in May 2016 at Wetland C43, will remove all bog turtle special considerations from that drill area upon a negative result. At AM2, the wetland will be crossed with an open trench with special protection exclusion measures and monitoring by a QBTS. SPLP will also commit to protection of the A54 and A55 habitats through operation of the pipelines through the installation of no mowing signs, hand clearing, and limiting herbicide applications. The five adjacent wetlands (C44, AM1, AM2, C7, and C8) will be protected through implementation of the BMPs outlined within this conservation plan.

SPLP has committed to installing a series of piezometers within Wetlands A54 and A55 to monitor groundwater conditions before, during, and after the HDD takes place. A detailed plan will be submitted to the Service for review prior to installation and preconstruction groundwater monitoring will begin with installation of the piezometers within 2 weeks of receipt of USFWS approval of the plan and continue through construction and for 1-year following successful installation of the pipelines under these wetlands. SPLP will work with a QBTS to ensure installation and monitoring does not affect the species or alter habitat within these wetlands.

Through the design of the Project, SPLP has minimized disturbance to bog turtle wetlands as much as operationally possible by implementing pipeline reroutes around and HDD or dry-bore under bog turtle wetlands. The primary concern with HDD is the release of drilling mud into a sensitive resource. While the potential for inadvertent returns cannot be eliminated, SPLP has (in the case of geotechnical studies) or will implement pre-construction and construction minimization measures to reduce the potential for negative indirect or direct impacts on bog turtles. Given these measures, direct take of bog turtle is not reasonably likely to occur. Additionally, the Project's habitat modification will not reach the threshold of take established in the regulatory definition of harm, thus indirect take will not occur as well.

Based on SPLP commitments to the protection and conservation of bog turtles and what is known about the presence and/or potential presence of this species in the vicinity of the Project areas, Tetra Tech on behalf of SPLP concludes that the measures taken on the PPP has reduced potential impacts to insignificant and discountable levels and the Project is not likely to take or adversely affect the bog turtle.

APPENDIX A

Project Description and Overview Map

PENNSYLVANIA PIPELINE PROJECT

"PROJECT DESCRIPTION"

Sunoco Pipeline, L.P. (SPLP) proposes to construct and operate the Pennsylvania Pipeline Project (Project) that would expand existing pipeline systems to provide natural gas liquid (NGL) transportation of up to 350,000 barrels per day. The Project involves the installation of approximately two parallel pipelines within a 306-mile, 50-foot-wide right-of-way (ROW) from Houston, Washington County, Pennsylvania to SPLP's Marcus Hook facility in Delaware County, Pennsylvania with the purpose of interconnecting with existing SPLP Mariner East pipelines. A 20-inch diameter pipeline would be installed within the ROW from Houston to Marcus Hook (306 miles) and a second, up to 20-inch diameter pipeline, will also be installed in the same ROW. The second line is proposed to be installed from SPLP's Delmont Station, Westmoreland County, Pennsylvania to the Marcus Hook facility, paralleling the initial line for approximately 255 miles.

PURPOSE AND NEED

The Project will provide transportation service for up to 700,000 barrels per day of NGL's with the combined pipelines from the Utica and Marcellus Shale formations for both domestic and international markets. This Project will transport propane, butane and ethane. SPLP's upstream customers currently extract natural gas in the form of methane from the aforementioned geologic formations for distribution to the community. The natural gas will provide fuel for power generation, heating and cooking. NGLs are separated from the natural gas stream before it is shipped on the natural gas piping network. Upstream shippers are currently limited by the shortage of NGL transport systems. The Project will supply additional transportation services to ship these NGLs to an existing port facility. In addition, the Project will provide along its route across Pennsylvania various exit points for supply of desperately needed propane supplies, at affordable prices, to local Pennsylvania distributors for use as heating and/or cooking fuel by consumers in Pennsylvania and neighboring states, especially during peak demand periods when supplies would otherwise become short.. In addition, when completed, the Pennsylvania Pipeline Project will promote sustained economic development and jobs-creation throughout multiple regions in Pennsylvania.

FACILITIES AND SUPPORT SITES

Pipeline Facilities

The Project includes two new, up-to 20-inch diameter pipelines with maximum operating pressures (MOPs) of 1,480 pounds per square inch gauge (psig) installed within or adjacent to 306 miles of existing ROW corridors. The majority of the new ROW will be co-located adjacent to existing utility corridors, including approximately 230 miles of pipeline that will be co-located in the existing SPLP Mariner East pipeline system that is currently used for the transportation of NGL's. The following provides the details of the proposed pipeline facilities:

- Pipeline 1: Houston, Pennsylvania to Marcus Hook, Pennsylvania – This is an incremental expansion of the capacities of Sunoco Logistics to transport NGL's to the Marcus Hook facility. This Phase of the Project will include a 20 inch diameter steel pipeline and pump stations. The route of the pipeline is either inside or

adjacent to the existing Sunoco pipeline corridor and is approximately 306 miles long.

- Pipeline 2: Delmont, Pennsylvania to Marcus Hook, Pennsylvania –The pipeline route for the second pipeline will include 255 miles of pipeline that will parallel Pipeline 1.

Table 1. Pennsylvania Pipeline Project Pipeline Facilities

Type of Facility	Description	State	Pipeline 1 Length (miles)	Pipeline 2 Length (miles)	County
Pipeline	Installation of a 20-inch new butane/propane line from Houston PA to Marcus Hook, PA and up to 20-inch new ethane line in parallel from Delmont, PA to Marcus Hook, PA	PA	**19.9** **9.1** **37.8** **18.8** **23.3** **23.5** **26.2** **3.0** **10.4** **33.1** **6.5** **11.5** **19.7** **7.5** **20.4** **24.0** **11.7**	**0.0** **0.0** **15.0** **18.8** **23.3** **23.5** **26.2** **3.0** **10.4** **33.1** **6.5** **11.5** **19.7** **7.5** **20.4** **24.0** **11.7**	Washington Allegheny Westmoreland Indiana Cambria Blair Huntingdon Juniata Perry Cumberland York Dauphin Lebanon Lancaster Berks Chester Delaware
	Project Total		**306.4**	**254.6**	

Aboveground Facilities

Aboveground facilities in **Pennsylvania**:

- Houston, Pennsylvania has an existing facility which will connect to the pipeline. This Project will install meters on the outlets from existing storage, injection pumps, control valves, associated piping and accessory structures. Some new land disturbance may be required to accommodate this modification.

- Delmont, Pennsylvania has an existing site and this Project will expand the pump station with added booster pumps, associated piping and accessory structures. Some new land disturbance within the existing station site may be required to accommodate this modification.

- Ebensburg, Pennsylvania, SPLP will construct a new pump station with booster pumps, leak detection metering, associated piping and accessory structures adjacent to an existing station.

- Mount Union, Pennsylvania has an existing pump station and this Project will expand the pump station with added booster pumps, associated piping and accessory structures. Some new land disturbance may be required to accommodate this modification.

- Doylesburg, Pennsylvania has an existing pump station and this Project will expand the pump station with added booster pumps, associated piping and accessory structures. Some new land disturbance may be required to accommodate this modification.

- Middletown, Pennsylvania has an existing pump station and this Project will expand the pump station with added booster pumps, associated piping and accessory structures. Some new land disturbance may be required to accommodate this modification.

- Beckersville, Pennsylvania has an existing pump station and this Project will add to the pump station with leak detection metering, associated piping and accessory structures. Some new land disturbance may be required to accommodate this modification.

- Twin Oaks, Pennsylvania is an existing site and this Project will install custody transfer meters and control valves. Some new land disturbance may be required to accommodate this modification.

- There are 53 Mainline Valve sets planned for this Project, which will be placed at as many existing valve sites as possible. Some new land disturbance may be required to accommodate this modification.

Table 2. Pennsylvania Pipeline Project - Aboveground Facilities

Type of Facility	New/ Modification	Description	State	County
Pump Station	Modification	Houston	PA	Washington
Pump Station	Modification	Delmont	PA	Westmoreland
Pump Station	New	Ebensburg	PA	Cambria
Pump Station	Modification	Mt. Union	PA	Huntingdon
Pump Station	Modification	Doyelsburg	PA	Perry
Pump Station	Modification	Middletown	PA	Dauphin
Pump Station	Modification	Beckersville	PA	Berks
Meter Site	Modification	Twin Oaks	PA	Delaware

Support Sites (Company Material Storage Yards)

Pipe for the project will be stored at three existing storage yards. They are:

1. Durabond facility in McKeesport, PA.
2. Letterkenny Army Depot in Chambersburg, PA
3. York storage yard in Manchester, PA

Materials for fabrication of the above ground facilities on the project will be stored at an existing warehouse area located at Beach Bottom, WV. and at an existing warehouse at the Letterkenny Army Depot in Chambersburg, PA. Contractors will draw material from these Company yards as required during the construction of the project.

Support Sites (Pipe / Contractor Yards and Access Roads)

The contractor pipe yards will be used for equipment, miscellaneous pipe, and material storage, as well as temporary field offices and pipe preparation/field assembly areas during construction. Site selection and acquisition will continue throughout the planning and permitting stages of the Project. Contractors will be required to site pipe and contractor yards in previously developed areas that will require no new land disturbance.

Support Sites (Access Roads)

To the extent possible, SPLP will use existing public and private roads for temporary construction access to the mainline pipeline Right-of-Ways (ROWs) and aboveground facilities. SPLP is currently in the process of identifying potential temporary and permanent access roads and will provide detailed information relative to access road location, length, and land acreage requirements within all agency filings. SPLP will seek and obtain the necessary property rights and approvals from landowners and government agencies prior to the use or construction of such roads.

LAND REQUIREMENTS

The proposed Project would result in temporary access during construction of the proposed facilities. In general, during construction of the new pipeline, the width of the construction ROW would typically be 75 feet. The 75-feet would consist of a 50-foot-wide post-construction, permanently maintained ROW and 25-feet of temporary workspace to facilitate installation of the pipelines. The 25-feet would be restored and allowed to revert back to its pre-construction condition unless it is co-located with an existing permanently maintained ROW. Additional temporary work space (ATWS) would be needed at some areas to facilitate construction and would depend on site-specific requirements. All Workspaces would be clearly defined within project mapping and within agency and municipality applications. In the post-construction phase, ATWS's will be allowed to revert, or be restored to, pre-construction conditions.

Construction of the Project's aboveground facilities and the use of non-public access roads would have land requirements. Typically, new pump stations require approximately 3-4 acres of land and modifications to existing pump stations may require 2-3 acres of additional land. Support sites, such as pipe/contractor yards, are to be sited on previously disturbed areas and typically range from 5-25 acres in size. Temporary use would primarily be limited to existing non-public roads, driveways, and farm lanes that would require nothing or minor improvements. Permanent

access roads to stations or valve settings may also be required. All proposed temporary and permanent access roads would be clearly defined within project mapping and within agency and municipality applications. In the post-construction phase, temporary workspaces will be allowed to revert, or be restored to, pre-construction conditions.

Pennsylvania Pipeline Project

Sunoco Logistics

Mariner East Pipeline - Pennsylvania Pipeline Project

Sunoco Pipeline, L.P. (SPLP) proposes to construct and operate the Pennsylvania Pipeline Project (Project) that would expand existing pipeline systems to provide natural gas liquid (NGL) transportation of up to 350,000 barrels per day. The Project involves the installation of approximately two parallel pipelines within a 306-mile, 50-foot-wide right-of-way (ROW) from Houston, Washington County, Pennsylvania to SPLP's Marcus Hook facility in Delaware County, Pennsylvania with the purpose of interconnecting with existing SPLP Mariner East pipelines. A 20-inch diameter pipeline would be installed within the ROW from Houston to Marcus Hook (306 miles) and a second, up to 20-inch diameter pipeline, will also be installed in the same ROW. The second line is proposed to be installed from SPLP's Delmont Station, Westmoreland County, Pennsylvania to the Marcus Hook facility, paralleling the initial line for approximately 255 miles. In addition to the pipelines, modification and construction of new above ground facilities would be required to meet Project goals.

Buffalo District USACE

PADEP Northwest Regional Office

PADEP Northcentral Regional Office

PADEP Southwest Regional Office

Pittsburgh District USACE

PADEP Southcentral Regional Office

Baltimore District USACE

PADEP Southeast Regional Office

Philadelphia District USACE

Norfolk District USACE

Norfolk District USACE

Warren, McKean, Potter, Tioga, Crawford, Forest, Venango, Elk, Cameron, Lycoming, Mercer, Clarion, Jefferson, Clinton, Montour, Lawrence, Clearfield, Centre, Union, Butler, Armstrong, Snyder, Northumberla, Beaver, Indiana, Mifflin, Juniata, Cambria, Blair, Huntingdon, Perry, Dauphin, Berks, Bucks, Allegheny, Westmoreland, Lebanon, Montgomery, Washington, Somerset, Bedford, Fulton, Franklin, Adams, York, Lancaster, Chester, Delaware, Camden, Harrisburg, Cumberland

Allegany, Garrett, Morgan, Washington, Carroll, Harford, Cecil, New Castle, Gloucester, Salem, Mineral, Hampshire, Berkeley, Frederick, Jefferson, Baltimore, Baltimore City, Howard, Kent, Queen Anne's, Tucker, Grant, Hardy, Winchester, Clarke, Loudoun, Montgomery, Anne Arundel, Shenandoah, Warren, District of Columbia, Fairfax City, Arlington, Caroline, Talbot, Pendleton, Fauquier, Manassas Park, Manassas, Fairfax, Prince George's, Rappahannock, Prince William, Calvert, Page, Rockingham, Highland, Madison, Culpeper, Stafford, Charles, Harrisonburg, Augusta, Greene, Orange, King George, St. Mary's

Legend

- PPP 1
- PPP 2
- USACE Districts
- State Boundary
- County Boundary

PADEP Regions

- Northcentral
- Northeast
- Northwest
- Southcentral
- Southeast
- Southwest

Miles

0 10 20 30 40 50

N W E S

Source: World Street Map from ESRI Online. USACE Districts from USACE. State and County Boundaries from ESRI.

P:\GIS\Projects\112\C05958-PPP\MXD\PPP_Overview04302015

APPENDIX B

Geotechnical Report for HDDs across Bog Turtle Wetlands

PENNSYLVANIA PIPELINE PROJECT

Horizontal Directional Drill Geotechnical Study Summary

-with Bog Turtle Area Evaluations

General

Risk of pipeline construction impacts to sensitive habitats and species can be minimized utilizing HDD technology to place pipelines below surface elevations, preferably within bedrock where possible. It removes the potential for pipeline exposure and rupture in a safe manner without modifying or impacting sensitive areas, wetlands, streambeds, banks and the adjacent riparian buffer zone. Having an understanding of the underlying material location and composition allows engineers to determine drill feasibility as well as design the HDD in a manner that minimizes drilling problems, increase drilling efficiency, and decrease the likelihood for potential surface disturbance, such as an inadvertent return of drilling fluids or groundwater. Geotechnical borings provide data in regards to the subsurface geology to complete that understanding. A geotechnical evaluation can provide the following information to feed into the HDD design:

- Percentage of gravel within soils along the pipeline trajectory;
- Location of bedrock along the pipeline trajectory;
- The rock quality designation of bedrock if present;
- Presence of cobbles greater than 4" along the pipeline trajectory;
- Presence of mixed face soil/bedrock along the pipeline trajectory;
- Risk of return of drilling fluid to the surface;
- Evaluation of soil strength to resist drilling fluid pressure; and
- Likelihood to maintain borehole stability.

As mentioned, in assessing the suitability of HDD for a specific location, an understanding of the site geology is fundamental. This is accomplished by background research documents and a field geotechnical investigation. This will forecast the types of materials to be expected as well as the potential for anomalous impediments (boulders, cobble fields, etc.) influencing the HDD construction process. Geotechnical information, along with several other data points (e.g., topography, surface hydrology), allows for proper selection of the entry and exit locations, entry and exit angles, and proper curvature and depths assuring the most suitable HDD path is selected allowing safe long-term installation of the pipe while minimizing the potential for returns of drilling fluids to the surface during installation.

To the extent practicable, SPLP has completed geotechnical borings along the alignment of all of the Project's HDDs and has used this data to feed back into the design for the HDD plans. The geotechnical borings results at each HDD are provided to the design engineers within a *Geotechnical Subsurface Investigation Report of Findings.* That report is part of a *Pipeline Calculation Document*, also prepared for each HDD, which is a compilation of all HDD data points to determine that all specifications are adequate for safe installation and operation of the HDD. That report receives Professional Engineer certification.

Bog Turtle Area HDDs

HDDs under bog turtle occupied wetlands is a primary avoidance measure. However, inadvertent return of drilling fluids to the surface of these wetlands is the primary threat to bog turtles. Therefore SPLP has implemented measures to ensure the potential for returns are reduced, including geotechnical investigations. At each of the bog turtle wetland, a summary of the HDD evaluation is provided below.

HDD PA-LA-0014.0000 (W-A55 and W-A54)

After consideration of the all data points, including the sensitivity of the area and geotechnical results, the preliminary design of this drill has been found to be adequate for safe installation and operation (see Attachment A for the drill design and the geotechnical investigation report).

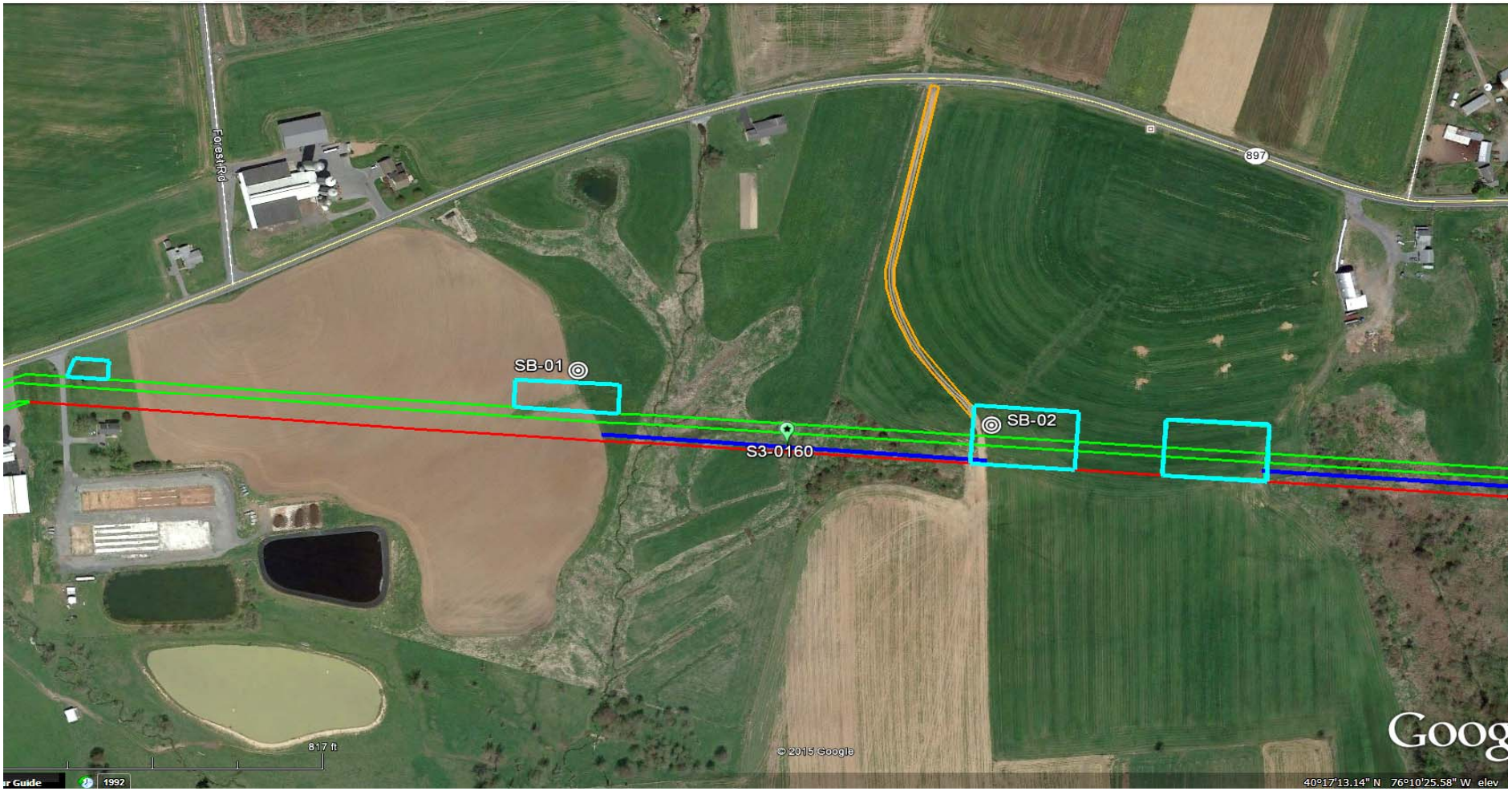
The drill would enter/exit 250 feet from the edge of the western most boundary of the wetland A55PEM. The drill would pass 25 feet under the western most boundary of wetland A55PEM and 60 feet under the eastern most boundary of Wetland A55PEM. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be weathered siltstone/sandstone.

The drill would continue beneath the western most boundary of the wetland A54PEM and would enter/exit 125 feet from the eastern most edge of wetland A54PEM. The drill would pass 60 feet under the western most boundary of wetland A54PEM and 20 feet under the eastern most boundary of Wetland A54PEM. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be weathered siltstone/sandstone. Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable. Implementing this design, along with adherence to the *Pennsylvania Pipeline Project Inadvertent Return Contingency Plan – with Special Bog Turtle Procedures* will ensure the bog turtle is not impacted as result of this HDD.

HDD PA-CH-0111.0000 (W-C43)

After consideration of the all data points, including the sensitivity of the area and geotechnical results, the preliminary design of this drill has been found to be adequate for safe installation and operation (see Attachment A for the drill design and the geotechnical investigation report).

The drill would enter/exit 1,000 feet from the edge of the western most boundary of wetland W-C43PEM/PFO and would enter/exit 110 feet from the eastern most edge of wetland W-C43PEM/PFO. The drill would pass 80 feet under the western most boundary of wetland W- C43PEM/PFO and 10 feet under the eastern most boundary of W-C43PEM/PFO. Using the results of the geotechnical investigation, as well as several other data points, the entry/exit, angles, and depths have been configured to pass through the best substrates while maintaining pipe integrity (e.g., no large bends). The majority of the substrate that will be passed through is estimated to be a silty sand or clay at either ends of the wetland and a graphitic felsic gneiss beneath the central portion of the wetland. Given the design, the threat of inadvertent return has been reduced to the maximum extent practicable. Implementing this design, along with adherence to the *Pennsylvania Pipeline Project Inadvertent Return Contingency Plan – with Special Bog Turtle Procedures* will ensure the bog turtle is not impacted as result of this HDD.



LEGEND:

◎ Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0160
LANCASTER COUNTY, WEST COCALICO TOWNSHIP, PA
SUNOCO PENNSYLVANIA PIPELINE PROJECT

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

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	RT 897, DENVER, PA		Page 1 of 1
HDD No.:	S3-0160	Dates(s) Drilled: 12-13-14	Inspector: E. WATT
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 15.0	Total Depth (ft): 30.0
Boring Location Coordinates:		40° 17' 3.801" N	76° 10' 36.352" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.1			TOPSOIL (<1")					
1	3.0	5.0	0.1		14		REDDISH BROWN TO GRAYISH BROWN FINE TO MEDIUM SAND WITH	4	16	20	22	**36**
							A LITTLE SILT, TRACE FINE QUARTZ GRAVEL.					
2	8.0	10.0			24		REDDISH BROWN FINE TO COARSE SAND WITH SOME SILT, TRACE	2	14	10	12	**24**
						SM	CONGLOMERATE MATRIX.					
3	13.0	14.5			18		REDDISH BROWN FINE SAND AND SILT, WITH A LITTLE	4	25	50		**75**
							CONGLOMERATE MATRIX.					
4	18.0	19.4			14		REDDISH BROWN FINE SAND AND SILT, WITH A LITTLE	9	33	50/5"		**>50**
				21.5			CONGLOMERATE MATRIX.					
5	23.0	23.9	21.5		10	SC	REDDISH BROWN FINE SAND AND SILTY CLAY, WITH A LITTLE	2	50/5"			**>50**
				26.0			FINE TO COARSE UNWEATHERED GRAVEL (USCS: SC)					
6	28.0	28.8	26.0		9	CL	REDDISH BROWN SILTY CLAY AND FINE SAND, WITH A LITTLE	23	50/4"			**>50**
				30.0			FINE TO COARSE UNWEATHERED GRAVEL.					
							AUGERED TO 30'.					
							WET ON SPOON AT 15'.					
							WATER LEVEL THROUGH AUGERS AT 17'.					
							CAVED AT 28'.					

Notes/Comments:
Pocket Pentrometer Testing

DR: DECOMPOSED ROCK

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

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

TETRA TECH
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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	MIDDLECREEK WILDLIFE MANAGEMENT AREA, NEWMANSTOWN, PA		Page 1 of 1
HDD No.:	S3-0160	Dates(s) Drilled: 11-20-14	Inspector: E. WATT
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 17.0	Total Depth (ft): 53.0
Boring Location Coordinates:		40° 17' 2.346" N	76° 10' 23.538" 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	0.7			TOPSOIL (8")					
1	3.0	5.0	0.7		24		MAROON SILTY CLAY AND FINE SAND, TRACE QUARTZ FINE	3	10	11	10	**21**
						CL	GRAVEL.					
2	8.0	10.0			8		MAROON MICACEOUS SILTY CLAY WITH SOME FINE SAND.	3	4	3	3	**7**
				13.5			(USCS: CL).					
3	13.0	13.9	13.5		11		MAROON FINE TO MEDIUM SAND WITH A LITTLE CLAYEY SILT, TRACE	28	50/5"			**>50**
							FINE GRAVEL.					
4	18.0	18.9			12		MAROON FINE TO MEDIUM SAND WITH A LITTLE CLAYEY SILT, TRACE	14	50/5"			**>50**
							FINE GRAVEL.					
5	23.0	25.0			16		MARRON FINE SAND WITH SOME CLAYEY SILT, TRACE	3	11	28	50	**39**
							CONGLOMERATE.					
6	28.0	29.0			11		MAROON FINE TO MEDIUM SAND WITH SOME CLAYEY SILT, TRACE	9	50/6"			**>50**
						SM	CONGLOMERATE.					
7	33.0	34.0			12		MAROON FINE SAND AND CLAYEY SILT, TRACE CONGLOMERATE.	28	50/6"			**>50**
8	38.0	38.9			8		MAROON FINE SAND AND CLAYEY SILT, TRACE CONGLOMERATE.	8	50/5"			**>50**
							(USCS: SM)					
9	43.0	43.9			10		MAROON MEDIUM TO COARSE SAND WITH SOME CLAYEY SILT,	12	50/5"			**>50**
				44.0			TRACE FINE QUARTZ GRAVEL.					
10	44.6	45.0	44.0	45.0	4		PARTIALLY WEATHERED SILTSTONE/SANDSTONE.	50/5"				**>50**
							AUGER REFUSAL AT 44.6'.					
							ROCK CORING					
RUN 1	45.0	48.0	45.0		20		HIGHLY FRACTURED AND WEATHERED REDDISH BROWN	TCR: 55%, SCR: 0%, RQD: 0%				
				49.3			SILTSTONE.					
RUN 2	48.0	53.0	49.3		60		HIGHLY FRACTURED AND WEATHERED MAROON SILTSTONE AND	TCR: 100%, SCR: 12%, RQD: 9%				
				51.3			MEDIUM TO COARSE GRAINED SANDSTONE INTERBEDS.					
			51.3				MODERATELY TO HIGHLY FRACTURED, MODERATELY WEATHERED					
				53.0		FRACTURED ROCK	MARRON SILTSTONE AND QUARTZ PEBBLE CONGLOMERATE.					

Notes/Comments:

Pocket Pentrometer Testing
S2: 0.5 TSF

DR: DECOMPOSED ROCK

WET ON SPOON AT 17'
WATER LEVEL THROUGH AUGERS AT 18'
CAVED AT 37'.

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 S3-0160

HDD No.	Test Boring No.	Sample No.	Depth of Sample (ft.)		Water Content, % (ASTM D2216)	Percent Silts/Clays, % (ASTM D1140)	Atterburg Limits (ASTM D4318)			USCS Classif. (ASTM D2487)
			From	To			Liquid Limit, %	Plastic Limit, %	Plasticity Index, %	
S3-0160	SB-01	2	8.0	10.0	10.9	29.2	-	-	-	-
		3	13.0	14.5	8.4	39.2	-	-	-	-
		4	18.0	19.4	7.0	41.2	-	-	-	-
		5	23.0	23.9	10.4	46.2	26	16	8	SC
		6	28.0	28.8	7.8	65.3	-	-	-	-
	SB-02 (Also S3-0170, SB-01)	2	8.0	10.0	16.7	78.1	27	16	11	CL
		4	18.0	18.9	11.3	19.7	-	-	-	-
		6	28.0	29.0	8.6	27.9	-	-	-	-
		8	38.0	38.9	10.7	44.4	18	18	NP	SM
		9	43.0	43.9	10.6	25.1	-	-	-	-

Notes:

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0160

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
S3-0160	Wetland A55	SB-01 SB-02	**Hammer Creek Formation** - Gray and pale red, fine- to coarse-grained quartzose sandstone, siltstone, and mudstone	Lowland, wetlands area	Hammer Creek Fm	sandstone with quartz pebble conglomerate	9,360	50-70	

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.

ROCK CORE DESCRIPTION SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0160

Location	Boring No.	Core Run	Core Depth (ft)		TCR (%)	SCR (%)	RQD (%)	Depth (ft)		Weathering	Classification	Bedding Thickness (ft)	Color	Discontinuity Data
			From	To				From	To					
S3-0160	SB-2	1	45	48	55	0	0	45	48	Heavily	Siltstone	Massive	Red	Heavily fractured, ranging from 0° to 45°
		2	48	53	100	12	9	48	53	Heavily	Siltstone with interbedded Sandstone	Massive, bedding is gradational	Red	Heavily fractured, ranging from 0° to 65°

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).

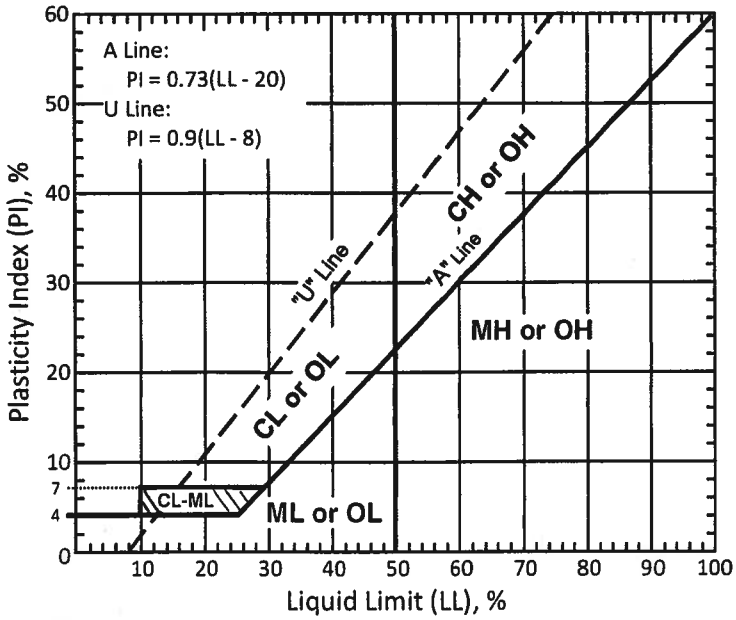
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

UNIFIED SOIL CLASSIFICATION SYSTEM [Casagrande (1948)]

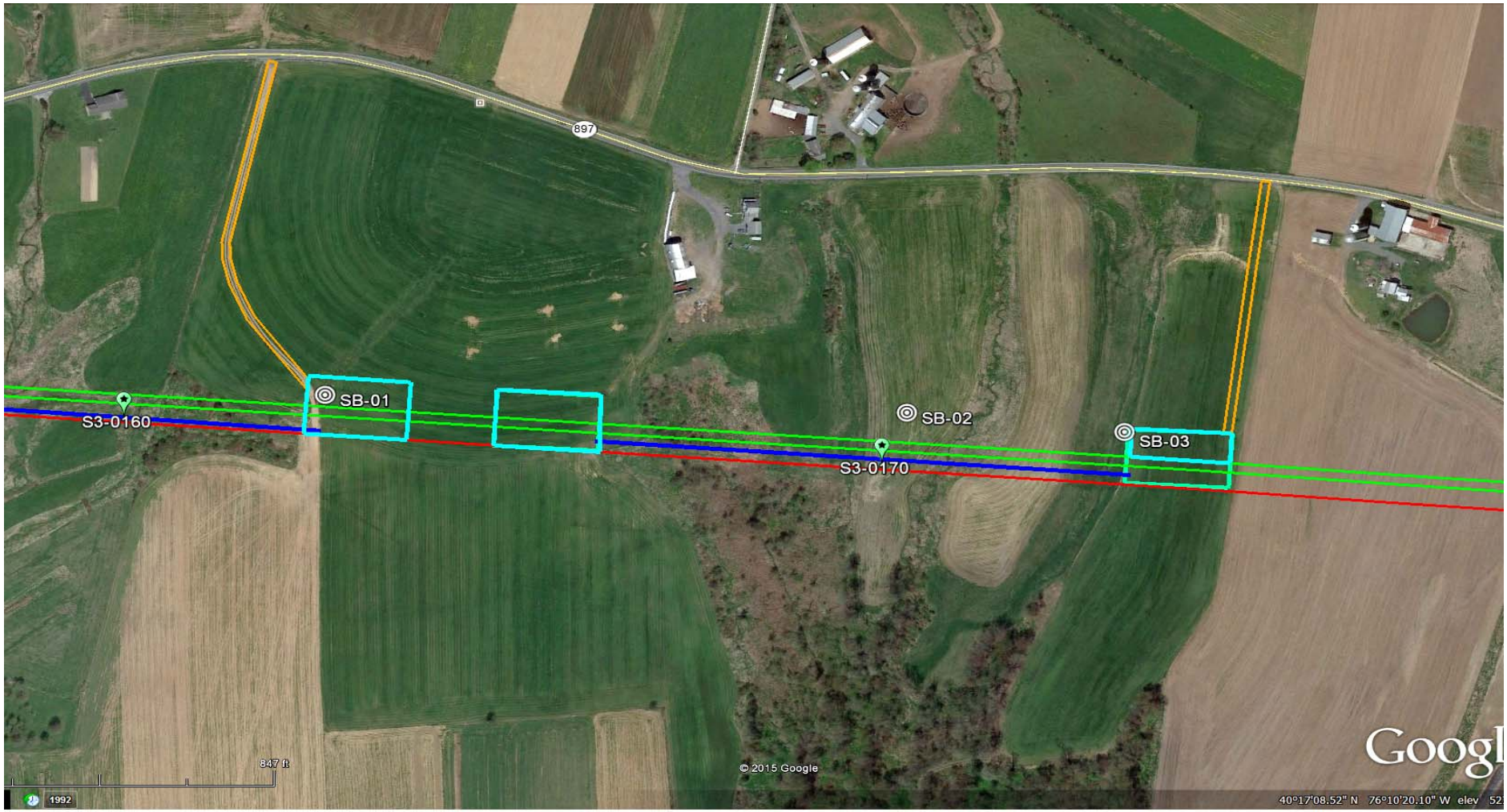
Major Divisions			Group Symbols	Typical Descriptions	Laboratory Classifications		
Coarse Grained Soils (More than half of material is larger than No. 200 sieve)	Gravels More than half of coarse fraction is larger than No. 4 sieve	Clean gravel (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, 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.



LEGEND:

◎ Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0170
LANCASTER COUNTY, WEST COCALICO TOWNSHIP, PA
SUNOCO PENNSYLVANIA PIPELINE PROJECT

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

TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	RT 897, DENVER, PA		Page 1 of 1
HDD No.:	S3-0170	Dates(s) Drilled: 11-20-14	Inspector: E. WATT
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 17.0	Total Depth (ft): 53.0
Boring Location Coordinates:		40° 17' 2.346" N	76° 10' 23.538" 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	0.7			TOPSOIL (8")					
1	3.0	5.0	0.7		24		MAROON SILTY CLAY AND FINE SAND, TRACE QUARTZ FINE	3	10	11	10	**21**
						CL	GRAVEL.					
2	8.0	10.0			8		MAROON MICACEOUS SILTY CLAY WITH SOME FINE SAND.	3	4	3	3	**7**
				13.5			(USCS: CL).					
3	13.0	13.9	13.5		11		MAROON FINE TO MEDIUM SAND WITH A LITTLE CLAYEY SILT, TRACE	28	50/5"			**>50**
							FINE GRAVEL.					
4	18.0	18.9			12		MAROON FINE TO MEDIUM SAND WITH A LITTLE CLAYEY SILT, TRACE	14	50/5"			**>50**
							FINE GRAVEL.					
5	23.0	25.0			16		MARRON FINE SAND WITH SOME CLAYEY SILT, TRACE	3	11	28	50	**39**
							CONGLOMERATE.					
6	28.0	29.0			11		MAROON FINE TO MEDIUM SAND WITH SOME CLAYEY SILT, TRACE	9	50/6"			**>50**
						SM	CONGLOMERATE.					
7	33.0	34.0			12		MAROON FINE SAND AND CLAYEY SILT, TRACE CONGLOMERATE.	28	50/6"			**>50**
8	38.0	38.9			8		MAROON FINE SAND AND CLAYEY SILT, TRACE CONGLOMERATE.	8	50/5"			**>50**
							(USCS: SM)					
9	43.0	43.9			10		MAROON MEDIUM TO COARSE SAND WITH SOME CLAYEY SILT,	12	50/5"			**>50**
				44.0			TRACE FINE QUARTZ GRAVEL.					
10	44.6	45.0	44.0	45.0	4		PARTIALLY WEATHERED SILTSTONE/SANDSTONE.	50/5"				**>50**
							AUGER REFUSAL AT 44.6'.					
							ROCK CORING					
RUN 1	45.0	48.0	45.0		20		HIGHLY FRACTURED AND WEATHERED REDDISH BROWN	TCR: 55%, SCR: 0%, RQD: 0%				
				49.3			SILTSTONE.					
RUN 2	48.0	53.0	49.3		60		HIGHLY FRACTURED AND WEATHERED MAROON SILTSTONE AND	TCR: 100%, SCR: 12%, RQD: 9%				
				51.3			MEDIUM TO COARSE GRAINED SANDSTONE INTERBEDS.					
			51.3				MODERATELY TO HIGHLY FRACTURED, MODERATELY WEATHERED					
				53.0		FRACTURED ROCK	MARRON SILTSTONE AND QUARTZ PEBBLE CONGLOMERATE.					

Notes/Comments:

Pocket Pentrometer Testing
S2: 0.5 TSF

WET ON SPOON AT 17'
WATER LEVEL THROUGH AUGERS AT 18'
CAVED AT 37'.

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

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

TETRA TECH
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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	RT 897, DENVER, PA		Page 1 of 1
HDD No.:	S3-0170	Dates(s) Drilled: 02-06-15	Inspector: E. WATT
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 13.0	Total Depth (ft): 44.0
Boring Location Coordinates:		40° 17' 1.883" N	76° 10' 5.380" 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	0.7			TOPSOIL (8")					
1	3.0	5.0	0.7		22		MOTTLED (REDDISH BROWN, GRAY AND ORANGE BROWN) FINE TO	3	7	11	14	**18**
							MEDIUM SAND, WITH SOME SILTY CLAY, TRACE FINE GRAVEL.					
2	8.0	10.0			18		REDDISH BROWN FINE TO MEDIUM SAND WITH SOME SILTY CLAY,	3	2	4	5	**6**
						SC	TRACE FINE GRAVEL.					
3	13.0	14.9			17		REDDISH BROWN FINE TO MEDIUM SAND AND SILTY CLAY, WITH A	13	27	44	50/5"	**>50**
							LITTLE UNWEATHERED ROCK FRAGMENTS. (USCS: SC)					
4	18.0	19.0			12		REDDISH BROWN FINE TO MEDIUM SAND AND SILTY CLAY, WITH A	11	50/6"			**>50**
				21.0			LITTLE UNWEATHERED ROCK FRAGMENTS. (USCS: SC)					
5	23.0	25.0	21.0		24		REDDISH BRWON SILTY CLAY, TRACE FINE SAND, WITH TRACE	15	27	25	35	**52**
							UNWEATHERED ROCK FRAGMENTS. (USCS: CL).					
6	28.0	28.8			10	CL	REDDISH BRWON SILTY CLAY, TRACE FINE SAND, WITH TRACE	20	50/4"			**>50**
							UNWEATHERED ROCK FRAGMENTS.					
7	33.0	33.6			8		REDDISH BROWN SILTY CLAY AND FINE SAND, WITH A LITTLE	30	50/2"			**>50**
				35.0			UNWEATHERED ROCK FRAGMENTS. (USCS: CL).					
8	38.0	38.7	35.0		8	WEATHERED SILTSTONE	REDDISH BROWN HIGHLY WEATHERED SILTSTONE.	38	50/3"			**>50**
9	43.0	43.7		44.0	7		REDDISH BROWN HIGHLY WEATHERED SILTSTONE.	25	50/3"			**>50**
							AUGER REFUSAL AT 44'.					

Notes/Comments:

Pocket Pentrometer Testing

S4 to S7: > 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.

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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	RT 897, DENVER, PA		Page 1 of 1
HDD No.:	S3-0170	Dates(s) Drilled: 12-13-14	Inspector: E. WATT
Boring No.:	SB-03	Drilling Method: SPT - ASTM D1586	Driller: S. HOFFER
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 6.0	Total Depth (ft): 30.0
Boring Location Coordinates:		40° 17' 1.365" N	76° 9' 58.579" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.3			TOPSOIL (3")					
1	3.0	5.0	0.3		11	SM	VARYING SHADES OF BROWN (TRACE WHITE) FINE TO COARSE	2	6	15	21	**21**
							SAND WITH A LITTLE SILT, TRACE FINE QUARTZ GRAVEL.					
2	8.0	10.0			22		REDDISH BROWN FINE TO COARSE SAND WITH A LITTLE SILT, TRACE	4	12	13	18	**25**
				11.5			FINE GRAVEL.					
3	13.0	15.0	11.5		17	SC	REDDISH BROWN FINE TO MEDIUM SAND WITH SOME SILTY CLAY,	16	26	25	35	**51**
							WITH A LITTLE FINE TO COARSE GRAVEL.					
4	18.0	18.8			9		REDDISH BROWN FINE TO MEDIUM SAND WITH SOME SILTY CLAY,	10	50/3"			**>50**
							WITH A LITTLE FINE TO COARSE GRAVEL.					
5	23.0	23.7			5		REDDISH BROWN FINE TO MEDIUM SAND WITH SOME SILTY CLAY,	8	50/3"			**>50**
							WITH A LITTLE FINE TO COARSE GRAVEL.					
6	28.0	29.3		30.0	0		NO RECOVERY	11	20	50/3"		**>50**
							AUGERED TO 30'.					
							WET ON SPOON AT 13'.					
							WATER LEVEL THROUGH AUGERS AT 6'.					
							CAVED AT 27'.					

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.

GEOTECHNICAL LABORATORY TESTING SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0170

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)
S3-0170	SB-01	2	8.0	10.0	16.7	78.1	27	16	11	CL
		4	18.0	18.9	11.3	19.7	-	-	-	-
		6	28.0	29.0	8.6	27.9	-	-	-	-
		8	38.0	38.9	10.7	44.4	18	18	NP	SM
		9	43.0	43.9	10.6	25.1	-	-	-	-
	SB-02	2	8.0	10.0	17.0	28.6	-	-	-	-
		3	13.0	14.9	9.6	41.2	28	20	8	SC
		5	23.0	25.0	17.7	92.5	27	16	11	CL
		6	28.0	28.8	10.9	98.7	-	-	-	-
		7	33.0	33.6	10.0	53.6	28	16	12	CL
	SB-03	1	3.0	5.0	12.5	18.3	-	-	-	-
		2	8.0	10.0	13.6	17.1	-	-	-	-
		3	13.0	15.0	9.8	23.4	-	-	-	-
		4	18.0	18.8	9.3	19.8	-	-	-	-
		5	23.0	23.7	10.5	24.6	-	-	-	-

Notes:

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0170

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
S3-0170	Wetland A54	SB-01	**Hammer Creek Formation** - Gray and pale red, fine- to coarse-grained quartzose sandstone, siltstone, and mudstone	Lowland, wetlands area	Hammer Creek Fm	sandstone with quartz pebble conglomerate	9,360	50-70	
		SB-02						50-75	
		SB-03						50-70	

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.

ROCK CORE DESCRIPTION SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0170

Location	Boring No.	Core Run	Core Depth (ft)		TCR (%)	SCR (%)	RQD (%)	Depth (ft)		Weathering	Classification	Bedding Thickness (ft)	Color	Discontinuity Data
			From	To				From	To					
S3-0170	SB-01	1	45	48	55	0	0	45	48	Heavily	Siltstone	Massive	Red	Heavily fractured, ranging from 0° to 45°
		2	48	53	100	12	9	48	53	Heavily	Siltstone with interbedded Sandstone	Massive, bedding is gradational	Red	Heavily fractured, ranging from 0° to 65°

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).

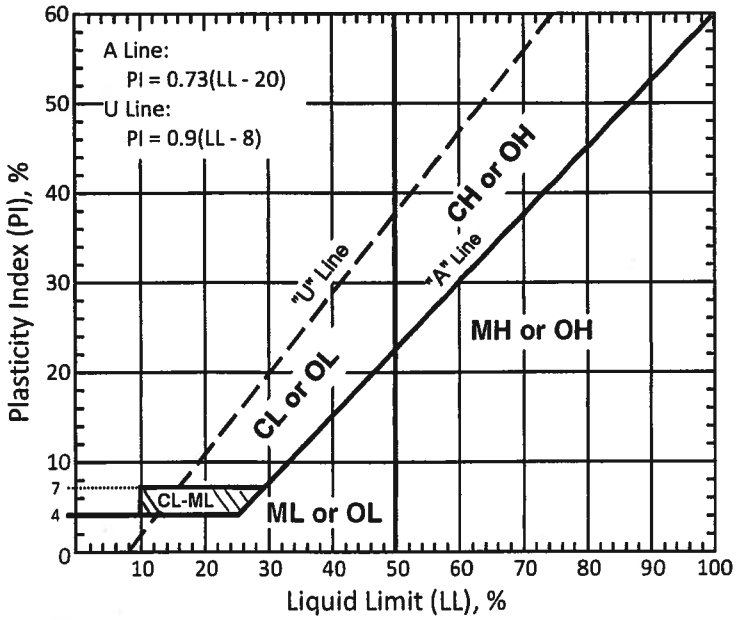
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

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.

LEGEND:

◎ Geotechnical Soil Boring (SB) Locations

TETRA TECH

GEOTECHNICAL BORING LOCATIONS
HDD S3-0300
CHESTER COUNTY, UPPER UWCHLAN TOWNSHIP, PA
SUNOCO PENNSYLVANIA PIPELINE PROJECT

TETRA TECH
240 Continental Drive, Suite 200
Newark, Delaware 19713
302.738.7551
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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	CH-0111, EXTON, PA		Page 1 of 1
HDD No.:	S3-0300	Dates(s) Drilled: 05-27-15	Inspector: J. COSTELLO
Boring No.:	SB-01	Drilling Method: SPT - ASTM D1586	Driller: GREG
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 16.0	Total Depth (ft): 30.0
Boring Location Coordinates:		40° 4' 27.416" N	75° 42' 1.033" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.5			TOPSOIL (6)					
1	3.0	5.0	0.5		9	SM	BROWN FINE TO MEDIUM SAND WITH SOME SILT, TRACE FINE	8	11	7	6	**18**
				6.5			GRAVEL.					
2	8.0	10.0	6.5		16		DR WEATHERED TO A YELLOWISH BROWN AND WHITE SILT AND	2	5	15	14	**20**
							FINE TO COARSE SAND, WITH A LITTLE UNWEATH. F-GRAVEL.					
3	13.0	15.0			24		DR WEATHERED TO A REDDISH BROWN WITH WHITE VEINS, SILT AND	3	5	10	19	**15**
						ML/ SM	FINE TO COARSE SAND, WITH TRACE UNWEATH. F-GRAVEL.					
4	18.0	20.0			19		DR WEATHERED TO A BRWN AND REDDISH BROWN SILT AND FINE	1	2	4	5	**6**
							SAND. (USCS: ML/SM).					
5	23.0	25.0			24		DR WEATHERED TO A BRWN AND REDDISH BROWN SILT AND FINE	1	1	2	6	**3**
				29.0			SAND.					
6	28.0	30.0	29.0		24	SM	DR WEATHERED TO A WHITE, TAN, GRAY FINE TO COARSE SAND WITH	1	13	26	28	**39**
				30.0			SOME SILT, TRACE FINE UNWEATHERED GRAVEL.					
							WET ON SPOON AT 16'.					
							WATER LEVEL THROUGH AUGERS AT 16'.					
							CAVED AT 26'.					

Notes/Comments:
Pocket Pentrometer Testing

DR: DECOMPOSED ROCK

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

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

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TEST BORING LOG

Project Name:	SUNOCO PENNSYLVANIA PIPELINE PROJECT		Project No.: 103IP3406
Project Location:	730 STOCKTON DRIVE, DOWNINGTOWN, PA		Page 1 of 1
HDD No.:	S3-0300	Dates(s) Drilled: 07-28-15	Inspector: J. COSTELLO
Boring No.:	SB-02	Drilling Method: SPT - ASTM D1586	Driller: E. OGDEN
Drilling Contractor:	HAD DRILLING	Groundwater Depth (ft): 18.0	Total Depth (ft): 30.0
Boring Location Coordinates:		40° 4' 13.433" N	75° 41' 36.139" W

Sample No.	Sample Depth (ft) From	Sample Depth (ft) To	Strata Depth (ft) From	Strata Depth (ft) To	Recov. (in)	Strata (USCS)	Description of Materials	6" Increment Blows *				N
			0.0	0.5			TOPSOIL (6)					
1	3.0	5.0	0.5		24	CL	MOTTLED REDDISH BROWN AND GRAY SILTY CLAY WITH A LITTLE	1	4	6	10	**10**
				9.0			FINE SAND.					
2	8.0	10.0	9.0		24	SM	DR, VARIEGATED (GRAY, WHITE, BROWN, RED) FINE TO MEDIUM SAND	2	2	5	6	**7**
							WITH SOME SILT.					
3	13.0	15.0			22		DR, VARIEGATED (GRAY, WHITE, BROWN, RED) FINE TO MEDIUM SAND	1	1	2	4	**3**
							WITH SOME SILT. (USCS: SM)					
4	18.0	20.0			15		DR, VARIEGATED (GRAY, WHITE, BROWN, RED) FINE TO MEDIUM SAND	1	2	3	6	**5**
							WITH SOME SILT.					
5	23.0	25.0			14		DR, VARIEGATED (GRAY, WHITE, BROWN, RED) FINE TO MEDIUM SAND	1	4	6	9	**10**
							WITH SOME SILT, TRACE FINE GNEISS FRAGMENTS.					
6	28.0	30.0			14		DR, VARIEGATED (GRAY, WHITE, BROWN, RED) FINE TO MEDIUM SAND	5	7	21	31	**28**
				30.0			WITH SOME SILT, TRACE FINE GNEISS FRAGMENTS.					
							WET ON SPOON AT 18'.					
							WATER LEVEL THROUGH AUGERS AT 18'.					
							CAVED AT 17.3'.					

Notes/Comments:

Pocket Pentrometer Testing
S1: 2.75 TSF

DR: DECOMPOSED ROCK

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

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

GEOTECHNICAL LABORATORY TESTING SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0300

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)
S3-0300	SB-01	2	8.0	10.0	12.9	21.6	-	-	-	-
		3	13.0	15.0	25.0	50.8	-	-	-	-
		4	18.0	20.0	34.7	51.9	43	33	10	ML/SM
		5	23.0	25.0	38.7	50.0	-	-	-	-
		6	28.0	30.0	13.5	24.6	NV	NP	NP	SM
	SB-02	2	8.0	10.0	23.5	20.5	-	-	-	-
		3	13.0	15.0	31.7	22.6	-	-	-	-
		4	18.0	20.0	41.7	33.1	30	25	5	SM
		5	23.0	25.0	32.2	28.7	-	-	-	-
		6	28.0	30.0	23.4	24.2	-	-	-	-

Notes:

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

REGIONAL GEOLOGY SUMMARY
SUNOCO PENNSYLVANIA PIPELINE PROJECT
HDD S3-0300

HDD No.	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
S3-0300	SB-01	Graphitic felsic gneiss - Includes Pickering Gneiss and small areas of marble; dominantly quartz and feldspar with varying amounts of graphite and various metamorphic minerals; medium grained, light to dark gray and greenish gray; sedimentary origin.	Gently sloping to the north	Graphitic felsic gneiss (PreCambrian)	Graphitic gneiss	Unknown	Approximately 25 ft bgs, see notes	Of the 14 well records within 0.25 miles of the site, only one had a recorded bedrock depth. Given the similar geology, bedrock depth is likely to be similar to other locations in this formation
	SB-02		Generally level, slightly sloping to the west					Of the 23 well records within 0.5 miles of the site, only one had a recorded bedrock depth. Given the similar geology, bedrock depth is likely to be similar to other locations in this formation

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).

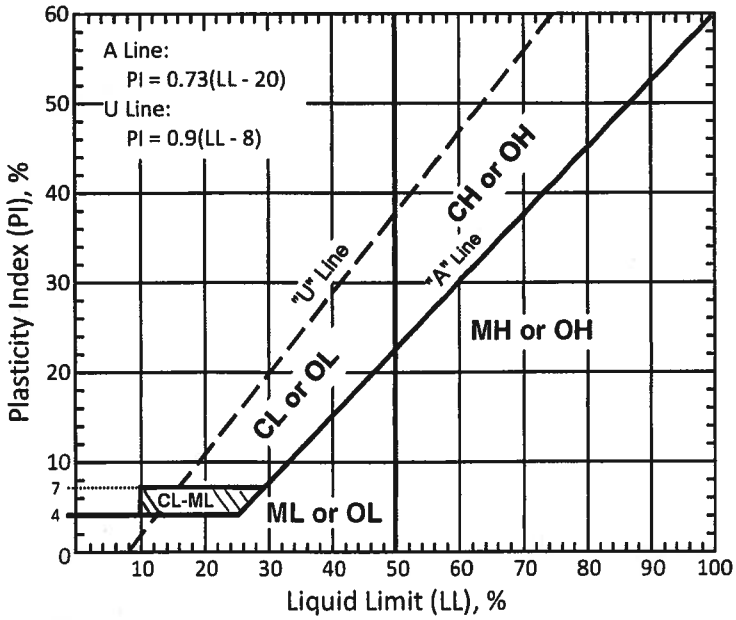
Groundwater observations were made at the times indicated. Groundwater elevations fluctuate throughout a given year, depending on actual field porosity and variations in seasonal and annual precipitation.

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

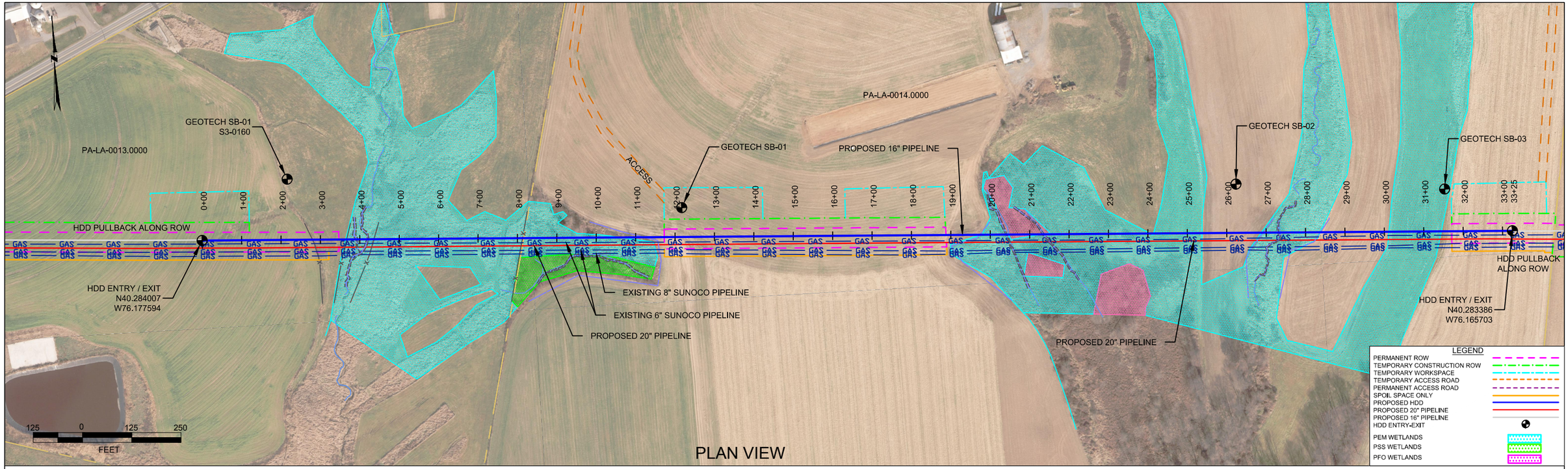
For soils plotting nearly on A line use dual symbols i.e ., I_p = 29.5, w_L=60 gives CH-MH. When w_L is near 50 use CL-CH or ML-MH. Take near as ± 2 percent.



(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.

APPENDIX C

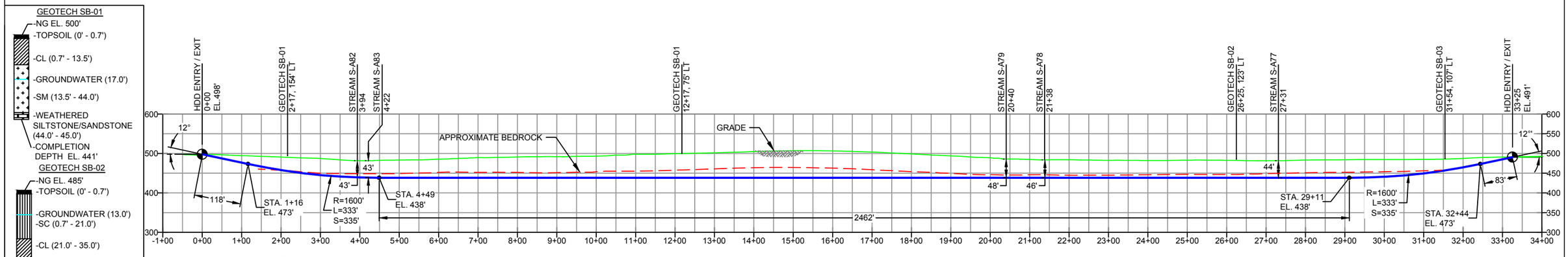
HDD and Bore Drawings



PLAN VIEW

PROFILE VIEW

LANCASTER COUNTY, PENNSYLVANIA - WEST COCALICO TOWNSHIP
S3-0161-16



GEOTECH SB-01
- NG EL. 500'
- TOPSOIL (0' - 0.7')
- CL (0.7' - 13.5')
- GROUNDWATER (17.0')
- SM (13.5' - 44.0')
- WEATHERED SILTSTONE/SANDSTONE (44.0' - 45.0')
- COMPLETION DEPTH EL. 441'

GEOTECH SB-02
- NG EL. 485'
- TOPSOIL (0' - 0.7')
- GROUNDWATER (13.0')
- SC (0.7' - 21.0')
- CL (21.0' - 35.0')
- WEATHERED SILT STONE (35.0' - 44.0')
- COMPLETION DEPTH EL. 441'

GEOTECH SB-03
- NG EL. 487'
- TOPSOIL (0' - 0.3')
- SM (0.3' - 11.5')
- GROUNDWATER (6.0')
- SC (11.5' - 30.0')
- COMPLETION DEPTH EL. 457'

NOTE: REFER TO TEST BORING LOG S3-0170 FOR COMPLETE SOIL MATERIAL DESCRIPTION

GEOTECH SB-01
- NG EL. 494'
- TOPSOIL (0' - 0.1')
- SM (0.1' - 21.5')
- GROUNDWATER (15.0')
- SC (21.5' - 26.0')
- CL (26.0' - 30.0')
- COMPLETION DEPTH EL. 464'

NOTE: REFER TO TEST BORING LOG S3-0160 FOR COMPLETE SOIL MATERIAL DESCRIPTION

DESIGN AND CONSTRUCTION:
1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXITING 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=):3325'
   HDD PIPE LENGTH (S=):3332'
   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.

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
2	DESIGN CHANGE	DLM	04/12/16	RMB	04/12/16	AAW	04/12/16
1	DESIGN CHANGE	MRS	02/24/16	RMB	02/24/16	AAW	02/24/16
0	ISSUED FOR CONSTRUCTION	MRS	01/21/16	RMB	01/21/16	AAW	01/21/16

Sunoco Logistics Partners L.P.

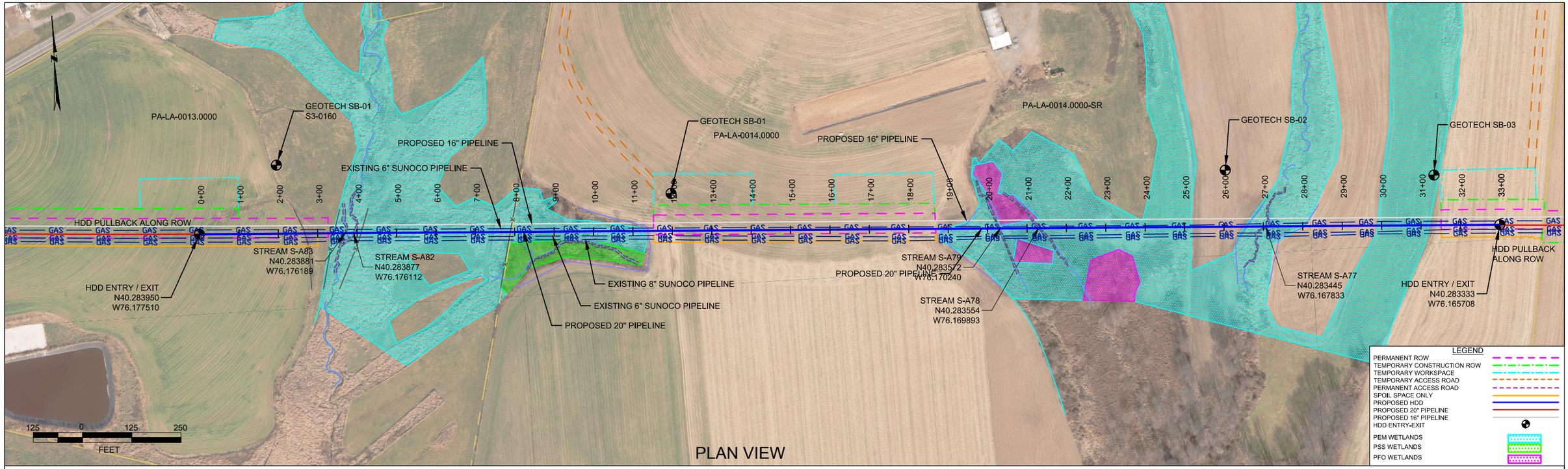
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
WETLAND A54 & A55
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=250'

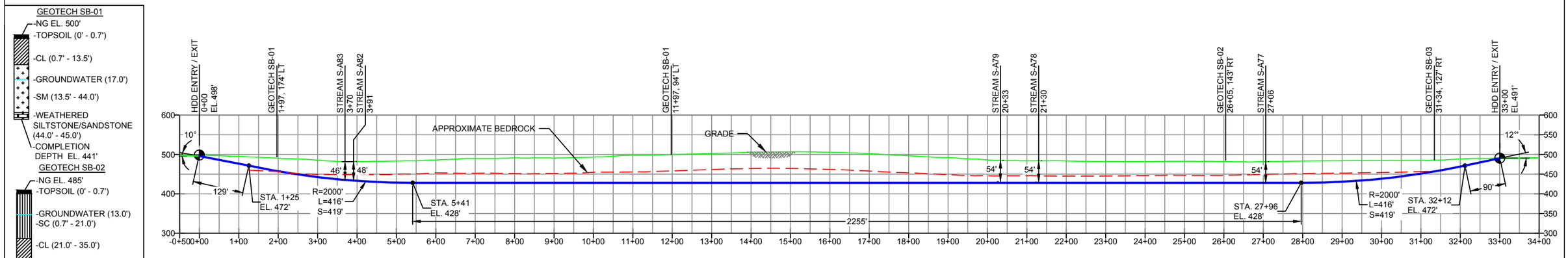
DWG. NO: PA-LA-0014.0000-SR-16



PLAN VIEW

PROFILE VIEW

LANCASTER COUNTY, PENNSYLVANIA - WEST COCALICO TOWNSHIP
S3-0161



GEOTECH SB-01
-NG EL. 500'
-TOPSOIL (0' - 0.7')
-CL (0.7' - 13.5')
-GROUNDWATER (17.0')
-SM (13.5' - 44.0')
-WEATHERED SILTSTONE/SANDSTONE (44.0' - 45.0')
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NOTE: REFER TO TEST BORING LOG S3-0160 FOR COMPLETE SOIL MATERIAL DESCRIPTION

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3. DESIGNED IN ACCORDANCE WITH CFR 49 195 & ASME B31.4
4. CROSSING PIPE SPECIFICATION:
   HDD HORZ. LENGTH (L=):3300'
   HDD PIPE LENGTH (S=):3312'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50 (HOOP STRESS)).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
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NOTES
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4. CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UTILITIES. CONTACT ONE CALL AT 811 PRIOR TO DIGGING.
5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
2	DESIGN CHANGE	DLM	04/12/16	RMB	04/12/16	AAW	04/12/16
1	DESIGN CHANGE	MRS	02/24/16	RMB	02/24/16	AAW	02/24/16
0	ISSUED FOR CONSTRUCTION	MRS	01/21/16	RMB	01/21/16	AAW	01/21/16

Sunoco Logistics Partners L.P.

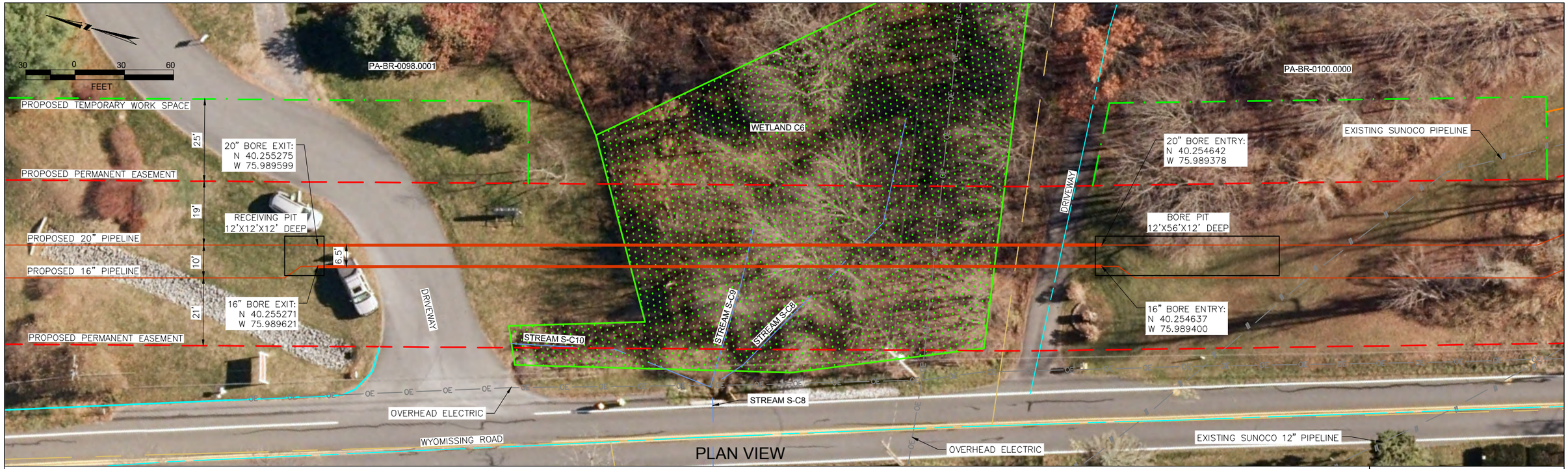
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
WETLAND A54 & A55
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=250'

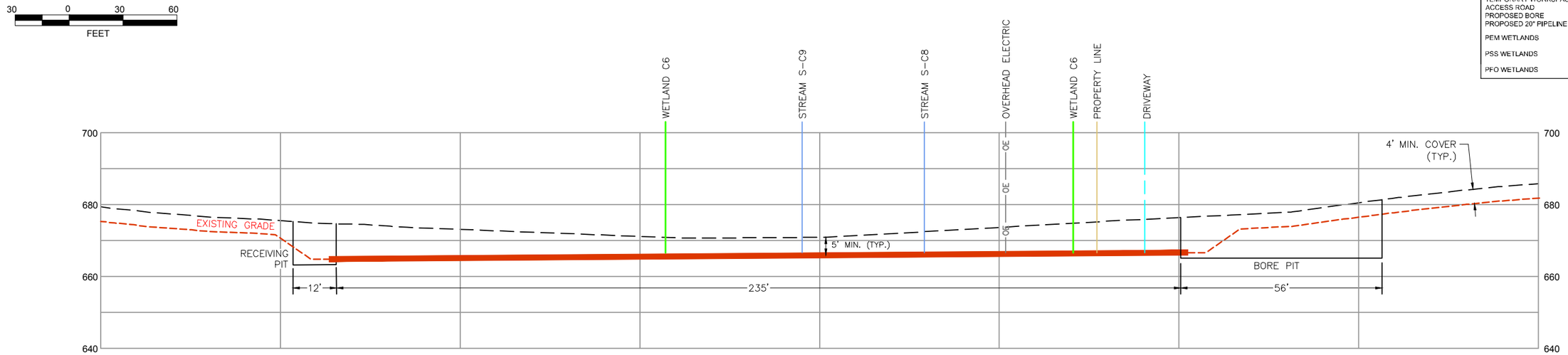
DWG. NUMBER: PA-LA-0014.0000-SR



PLAN VIEW

BERKS COUNTY, PENNSYLVANIA - CUMRU TOWNSHIP

PROFILE VIEW



LEGEND

- PERMANENT ROW
- TEMPORARY CONSTRUCTION ROW
- TEMPORARY WORKSPACE
- ACCESS ROAD
- PROPOSED BORE
- PROPOSED 20" PIPELINE
- PEM WETLANDS
- PSS WETLANDS
- PFO WETLANDS

CONSTRUCTION NOTES

1. STEEL PIPE: 20" OD x 0.456" WT, X-65, API-5L, PSL2, ERW, BFW, DRL
2. STEEL PIPE: 16" OD x 0.438 WT, X-70, API-5L, PSL2, ERW, BFW
3. COATING: 14 TO 16 MILS OF 3M SCOTCHKOTE TM 6233 FBE WITH 40 MILS MIN. DFT POWERCRETE R95.
4. DESIGN FACTOR: 0.50 (HOOP STRESS)
5. DESIGN PRESSURE: 1480 PSIG
   TEST PRESSURE: 1850 PSIG
6. WELDING PROCESSES: SUBMERGED ARC WELDING PROCESS OR SEMI-AUTOMATIC PROCESSES APPROVED BY THE CERTIFIED PIPELINE VENDER.
7. THE COATING ON THE CARRIER PIPE SHALL BE INSPECTED IMMEDIATELY PRIOR TO ITS INSTALLATION AND ALL DAMAGED COATING SHALL BE REPAIRED IN ACCORDANCE WITH SUNOCO'S PIPELINE COATING SPECIFICATIONS.
8. IN ADDITION TO THE SITE-SPECIFIC INFORMATION PROVIDED IN THIS DRAWING, GENERAL REQUIREMENTS INCLUDED IN PERMITS AND APPROVAL FROM FEDERAL, STATE AND LOCAL AGENCIES ALSO APPLY.

FOR PRELIMINARY USE ONLY

THIS DRAWING HAS BEEN DESIGNED FOR PRELIMINARY USE ONLY.
ONCE FIELD SURVEY IS OBTAINED, DESIGN WILL BE REVISED.

NOTES

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

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
A	ISSUED FOR REVIEW	JTW	02/25/16	CAG	02/25/16	AAW	02/25/16

Sunoco Logistics Partners L.P.

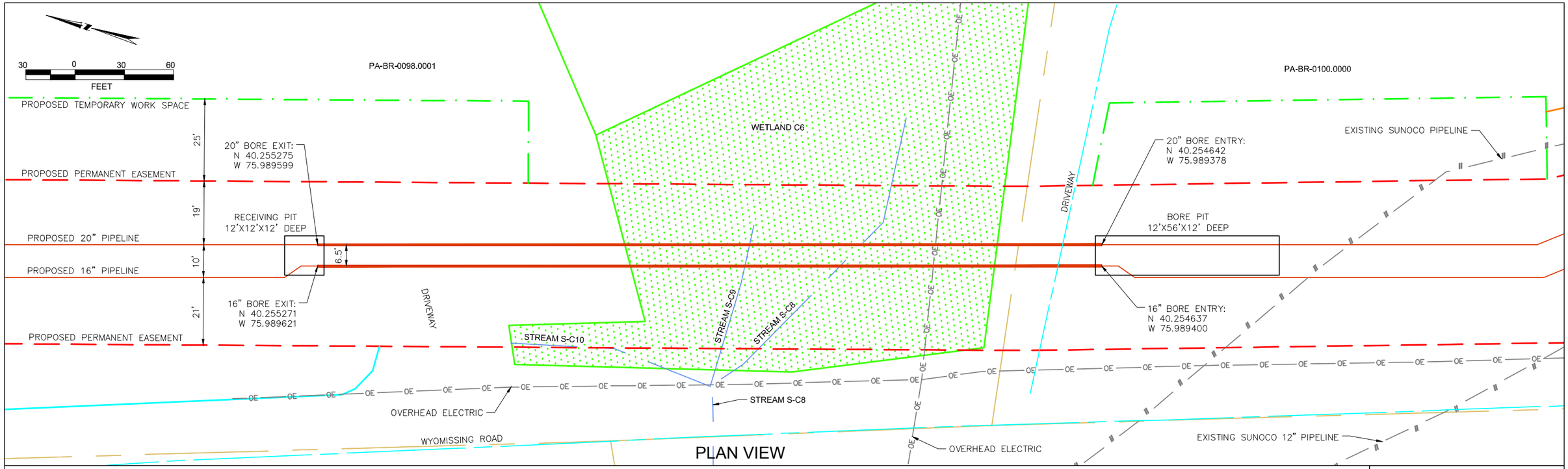
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

AUGER BORE
WETLAND
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=30'

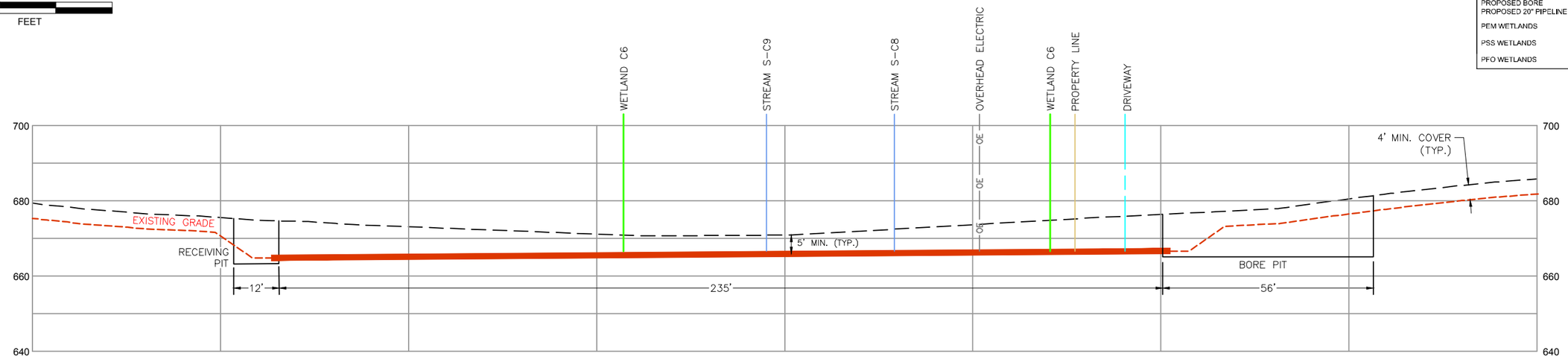
DWG. NUMBER: PA-BR-0098.0001



PLAN VIEW

PROFILE VIEW

BERKS COUNTY, PENNSYLVANIA - CUMRU TOWNSHIP



LEGEND

- PERMANENT ROW
- TEMPORARY CONSTRUCTION ROW
- TEMPORARY WORKSPACE
- ACCESS ROAD
- PROPOSED BORE
- PROPOSED 20" PIPELINE
- PEM WETLANDS
- PSS WETLANDS
- PFO WETLANDS

CONSTRUCTION NOTES

1. STEEL PIPE: 20" OD x 0.456" WT, X-65, API-5L, PSL2, ERW, BFW, DRL
2. STEEL PIPE: 16" OD x 0.438 WT, X-70, API-5L, PSL2, ERW, BFW
3. COATING: 14 TO 16 MILS OF 3M SCOTCHKOTE TM 6233 FBE WITH 40 MILS MIN. DFT POWERCRETE R95.
4. DESIGN FACTOR: 0.50 (HOOP STRESS)
5. DESIGN PRESSURE: 1480 PSIG
   TEST PRESSURE: 1850 PSIG
6. WELDING PROCESSES: SUBMERGED ARC WELDING PROCESS OR SEMI-AUTOMATIC PROCESSES APPROVED BY THE CERTIFIED PIPELINE VENDER.
7. THE COATING ON THE CARRIER PIPE SHALL BE INSPECTED IMMEDIATELY PRIOR TO ITS INSTALLATION AND ALL DAMAGED COATING SHALL BE REPAIRED IN ACCORDANCE WITH SUNOCO'S PIPELINE COATING SPECIFICATIONS.
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5. SUNOCO EMERGENCY HOTLINE NUMBER IS #1-800-786-7440.

REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
A	ISSUED FOR REVIEW	JTW	02/25/16	CAG	02/25/16	AAW	02/25/16

Sunoco Logistics Partners L.P.

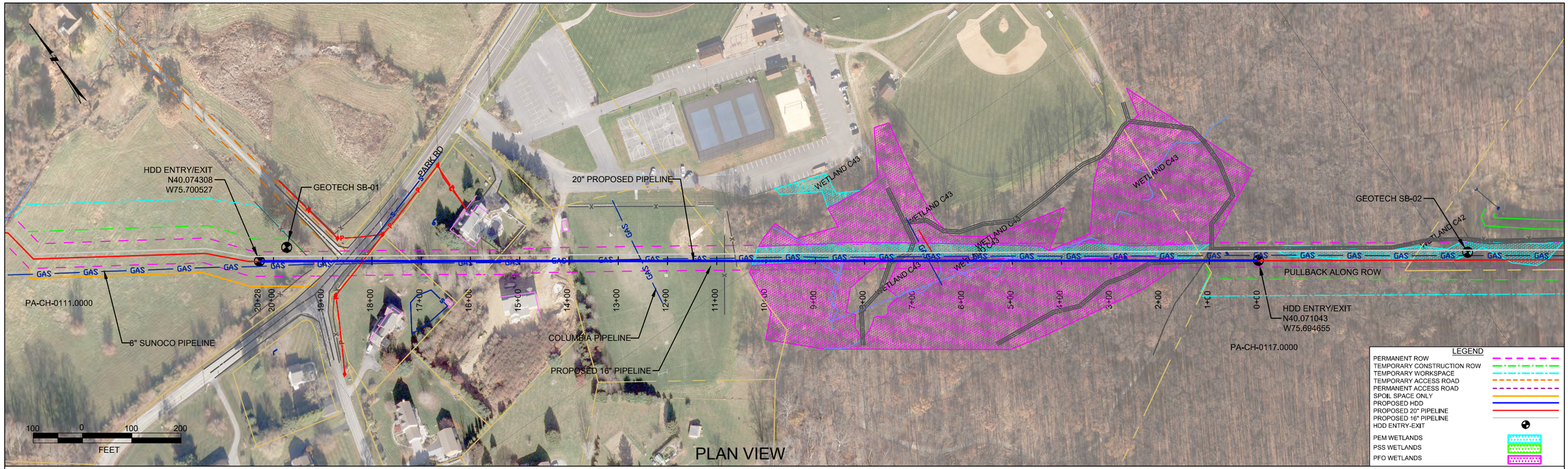
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

AUGER BORE
WETLAND
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=30'

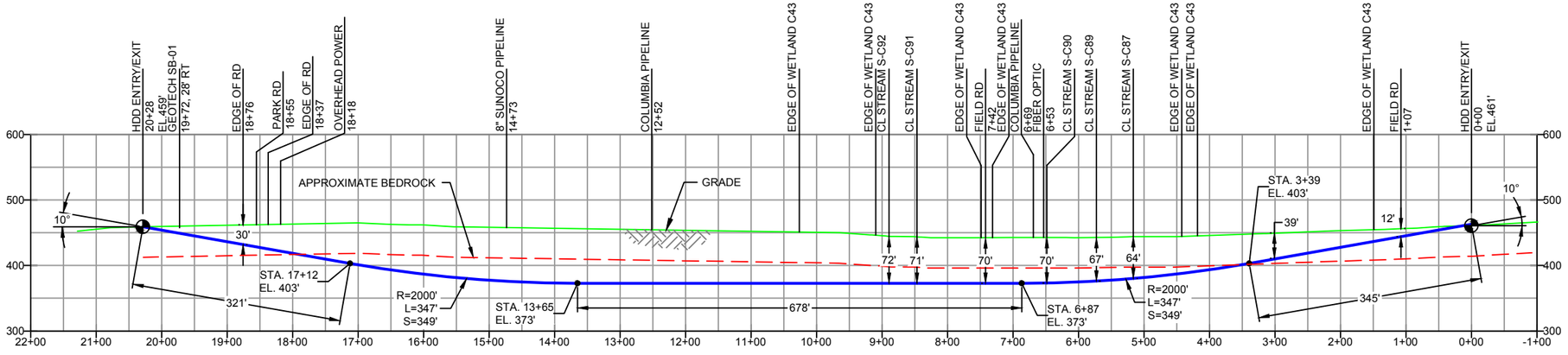
DWG. NUMBER: PA-BR-0098.0001



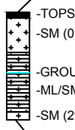
PLAN VIEW

PROFILE VIEW

CHESTER COUNTY, PENNSYLVANIA - UWCHLAN TOWNSHIP
S3-0300



GEOTECH SB-01



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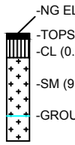

NOTE:
1.REFER TO TEST BORING LOG S3-0210 FOR COMPLETE SOIL MATERIAL DESCRIPTION
2. PDOT RECORD INDICATED GRAPHITIC FELSIC GNEISS AT 25'-35' DEPTH, REFER TO PaGWIS PENNSYLVANIA DEPARTMENT OF TRANSPORTATION

DESIGN AND CONSTRUCTION:
1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXITING 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=):2028'
   HDD PIPE LENGTH (S=):2042'
   20" x 0.456" W.T., X-65, API5L, PSL2, ERW, BFW
   COATING: 14-16 MILS FBE WITH 40 MILS MIN. ARO (POWERCRETE R95)
5. INTERNAL DESIGN PRESSURE 1480 PSIG (SEAM FACTOR 1.0, DESIGN FACTOR 0.50 (HOOP STRESS)).
6. INSTALLATION METHOD: HORIZONTAL DIRECTIONAL DRILL (HDD).
7. PIPELINE WARNING MARKERS SHALL BE INSTALLED ON BOTH SIDES OF ALL ROAD, RAILWAY, AND STREAM CROSSINGS.
8. CARRIER PIPE NOT ENCASED.
9. PIPE / AMBIENT TEMPERATURE MUST BE NO LESS THAN 30°F DURING PULLBACK WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER.
10. CONDUCT 4-HOUR PRE-INSTALLATION HYDROTEST OF HDD PIPE STRING TO MINIMUM 1850 PSIG.
11. SEE SUNOCO PENNSYLVANIA PIPELINE PROJECT ESRI WEBMAP FOR ACCESS ROAD ALIGNMENT.

NOT FOR CONSTRUCTION, ISSUED FOR PERMIT ONLY

NOTES
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REVISIONS

NO.	DESCRIPTION	BY	DATE	CHK	DATE	APP	DATE
EP	NOT FOR CONSTRUCTION, ISSUED FOR PERMIT	MRS	12/07/15	RMB	12/07/15	AAW	12/07/15
D	ADDED GEOTECH INFO	MRS	09/25/15	RMB	09/25/15	AAW	09/25/15
C	ISSUED FOR BID	DLM	08/21/15	RMB	08/21/15	AAW	08/21/15
B	ISSUED FOR BID	DLM	07/31/15	RMB	07/31/15	AAW	07/31/15
A	ISSUED FOR REVIEW	KB	03/26/15	RMB	03/26/15	AAW	03/26/15

Sunoco Logistics Partners L.P.

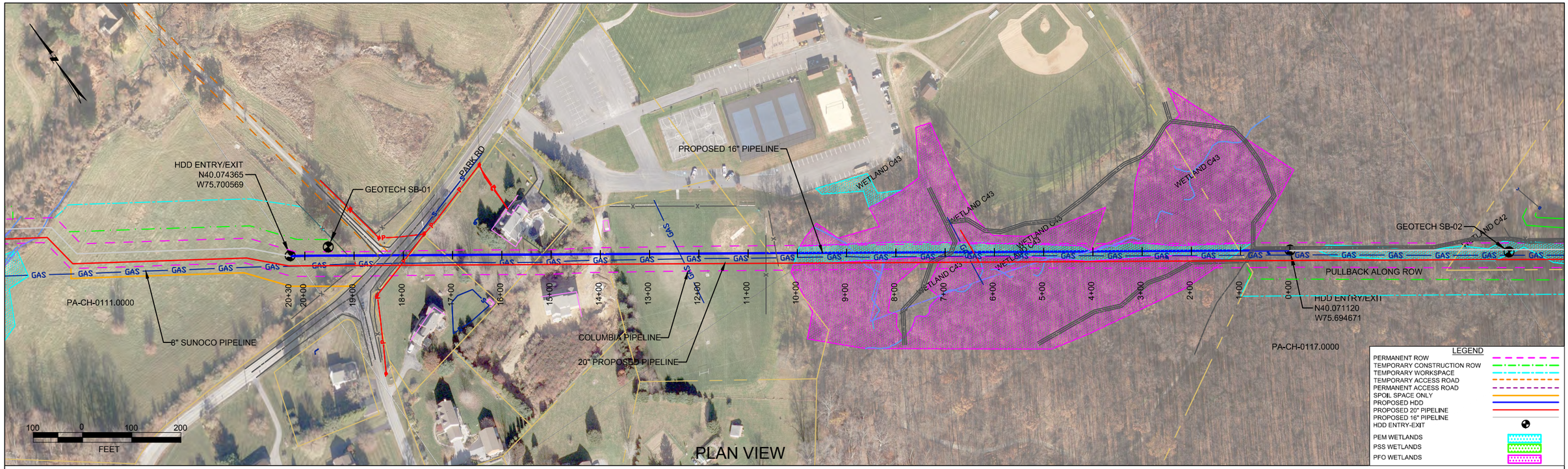
TETRA TECH ROONEY
(303) 792-5911

SUNOCO PIPELINE, L.P.

HORIZONTAL DIRECTIONAL DRILL
PARK ROAD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200'

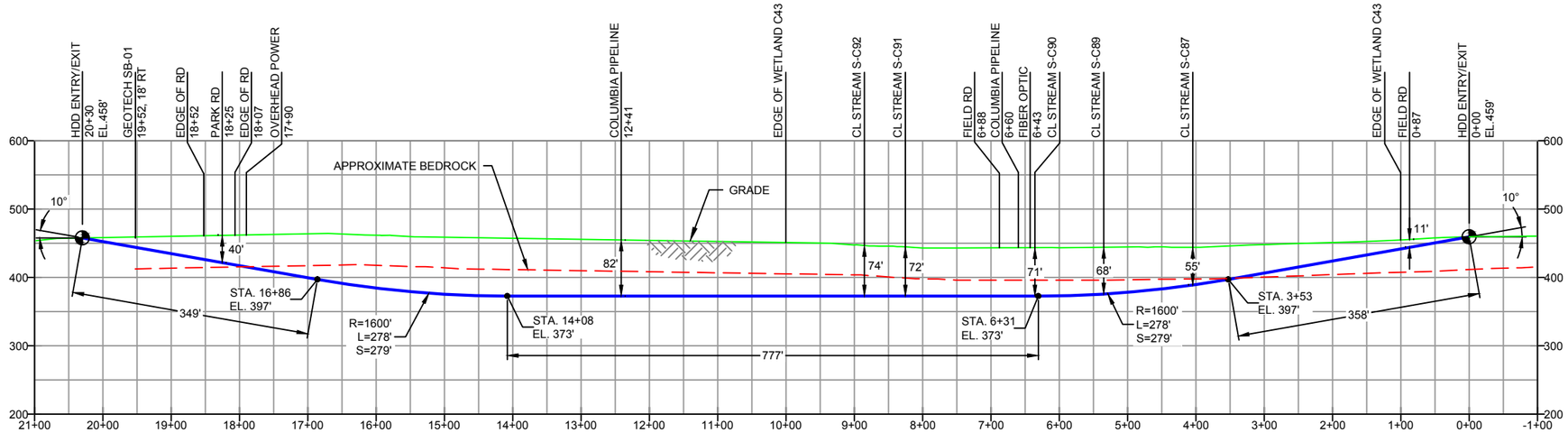
DWG. NUMBER: PA-CH-0111.0000-RD



PLAN VIEW

CHESTER COUNTY, PENNSYLVANIA - UWCHLAN TOWNSHIP
S3-0300-16

PROFILE VIEW



GEOTECH SB-01

GEOTECH SB-02

NOTE:
1.REFER TO TEST BORING LOG S3-0210 FOR COMPLETE SOIL MATERIAL DESCRIPTION
2. PDOT RECORD INDICATED GRAPHITIC FELSIC GNEISS AT 25'-35' DEPTH, REFER TO PaGWIS PENNSYLVANIA DEPARTMENT OF TRANSPORTATION

DESIGN AND CONSTRUCTION:
1. CONTRACTOR SHALL FIELD VERIFY DEPTH OF ALL EXITING 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 HOR2. LENGTH (L=):2030'
   HDD PIPE LENGTH (S=):2043'
   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.

NOT FOR CONSTRUCTION, ISSUED FOR PERMIT ONLY

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
EP	NOT FOR CONSTRUCTION, ISSUED FOR PERMIT	MRS	12/07/15	RMB	12/07/15	AAW	12/07/15
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
PARK RD
PENNSYLVANIA PIPELINE PROJECT

SCALE: 1"=200'

DWG. NO: PA-CH-0111.0000-RD-16

APPENDIX D

Bog Turtle Occupied and Assumed Presence Wetlands Figure Series

Contingent Workspace and Access Road
Only to be used for Emergency Access

Wetland A54
Occupied

Wetland A55
Occupied

S-A28
S-A29
S-A30
S-A31
S-A32
S-A33
S-A34

Notes:
1) Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2013 ESRI and its data suppliers).
2) Coordinate system is NAD 1983 SPCS Pennsylvania South.

Legend

- Stream
- Wetland
  - PEM
  - PFO
  - PSS
- PuB
- Access Road
- New Proposed Alignment Centerline
- New Proposed Limit of Disturbance

N

0 100 200 Feet

0 25 50 Meters

BOG TURTLE OCCUPIED AND ASSUMED PRESENCE WETLANDS
PENNSYLVANIA PIPELINE PROJECT
SUNOCO LOGISTICS, L.P.
LANCASTER COUNTY, PENNSYLVANIA

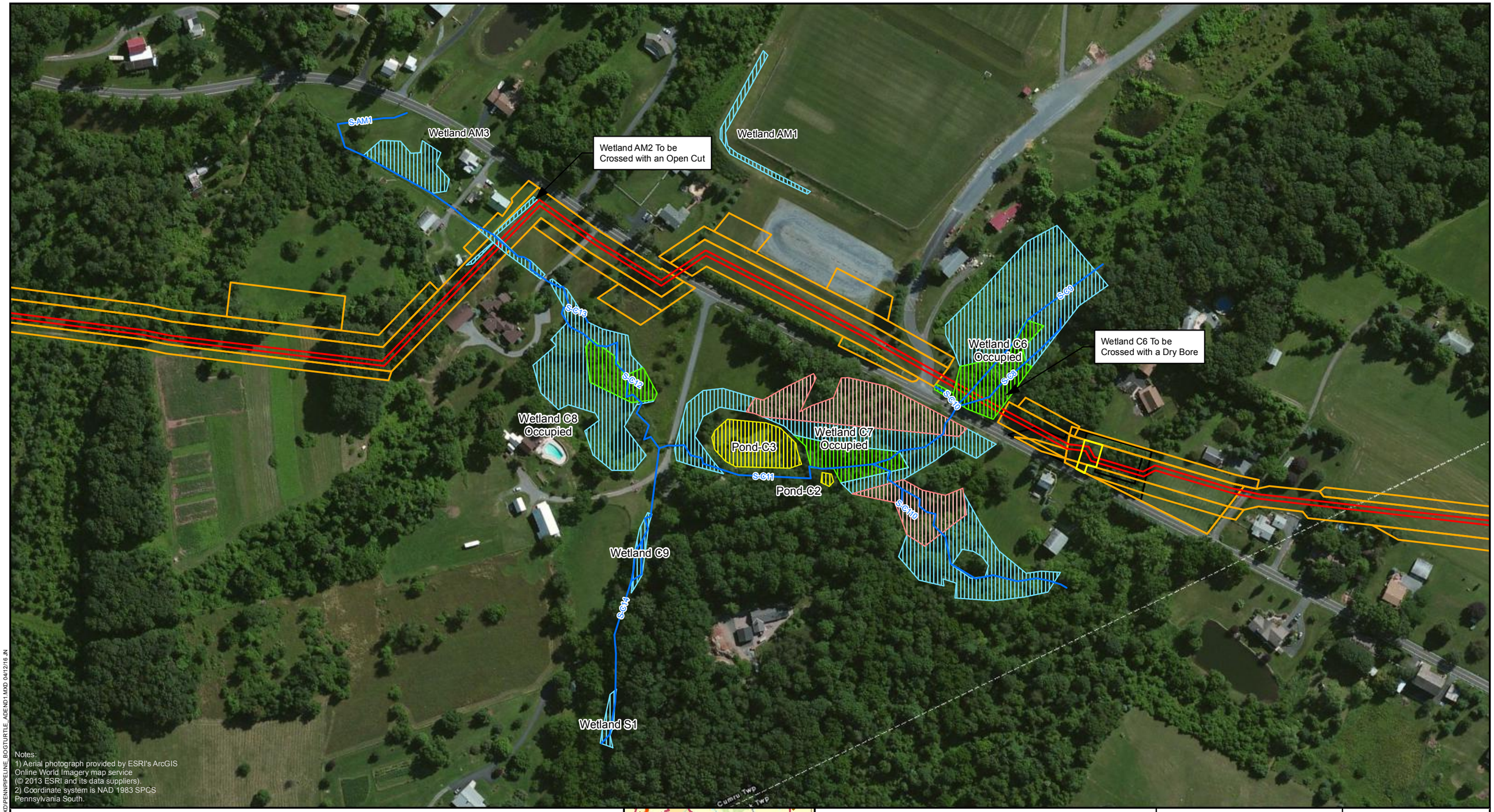
DRAWN BY: K. MOORE 2/6/14
CHECKED BY: P. SMITH 04/12/16
APPROVED BY:

CONTRACT NUMBER: 112IC05958

FIGURE 1A

REVISION 0

PGH P:\GIS\SUNOCO\MARINER EAST 2MXD\PENNPIPELINE_BOGTURTLE_ADEND1.MXD 04/12/16 JN



Notes:
1) Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2013 ESRI and its data suppliers).
2) Coordinate system is NAD 1983 SPCS Pennsylvania South.

Legend

- Stream
- **Wetland**
  - PEM
  - PFO
  - PSS
- PuB
- Access Road
- New Proposed Alignment Centerline
- New Proposed Limit of Disturbance

Feet: 0 100 200

Meters: 0 25 50

BOG TURTLE OCCUPIED AND ASSUMED PRESENCE WETLANDS
PENNSYLVANIA PIPELINE PROJECT
SUNOCO LOGISTICS, L.P.
BERKS COUNTY, PENNSYLVANIA

DRAWN BY: K. MOORE 2/6/14
CHECKED BY: P. SMITH 04/12/16
APPROVED BY:

CONTRACT NUMBER: 112IC05958

FIGURE 1B

REVISION 0

PGH P:\GIS\SUNOCO\MARINER EAST 2MX\DVPENNPIPELINE_BOGTURTLE_ADEND1.MXD 04/12/16 JN

Alignment Shifted
Outside of Wetland

Wetland C44
Occupied

Wetland C47

S-693

S-694

S-695

S-696

S-697

S-698

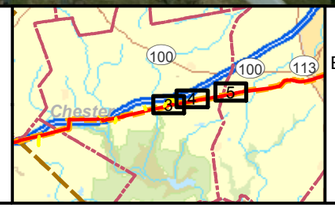
Notes:
1) Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2013 ESRI and its data suppliers).
2) Coordinate system is NAD 1983 SPCS Pennsylvania South.

Legend

- Stream
- **Wetland**
  - PEM
  - PFO
  - PSS
- PuB
- Access Road
- New Proposed Alignment Centerline
- New Proposed Limit of Disturbance

0 100 200 Feet

0 25 50 Meters



BOG TURTLE OCCUPIED AND ASSUMED PRESENCE WETLANDS
PENNSYLVANIA PIPELINE PROJECT
SUNOCO LOGISTICS, L.P.
CHESTER COUNTY, PENNSYLVANIA

DRAWN BY: K. MOORE 2/6/14
CHECKED BY: P. SMITH 04/12/16
APPROVED BY:

CONTRACT NUMBER: 112IC05958

FIGURE 1C

REVISION 0

PGH P:\GIS\SUNOCO\MARINER EAST 2MXD\PENNPIPELINE_BOGTURTLE_ADEND1.MXD 04/12/16 JN

11/12/16 Project Note: Per USFWS October 31, 2016 Correspondence C43 no longer is considered to be occupied habitat. This is no longer a bog turtle HDD

Approximately Only 0.1 ac of Core Habitat

Hickory Park

Unnamed Tributary to Marsh Creek

Pond-C41

Wetland C42

Wetland C43
Occupied

S-C88

S-C89

S-C90

S-C92

S-C87

Notes:
1) Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2013 ESRI and its data suppliers).
2) Coordinate system is NAD 1983 SPCS Pennsylvania South.

Legend

- Stream
- **Wetland**
  - PEM
  - PFO
  - PSS
- PuB
- Access Road
- New Proposed Alignment Centerline
- New Proposed Limit of Disturbance

0 100 200 Feet

0 25 50 Meters

BOG TURTLE OCCUPIED AND ASSUMED PRESENCE WETLANDS
PENNSYLVANIA PIPELINE PROJECT
SUNOCO LOGISTICS, L.P.
CHESTER COUNTY, PENNSYLVANIA

DRAWN BY: K. MOORE 2/6/14
CHECKED BY: P. SMITH 04/12/16
APPROVED BY:

CONTRACT NUMBER: 112IC05958

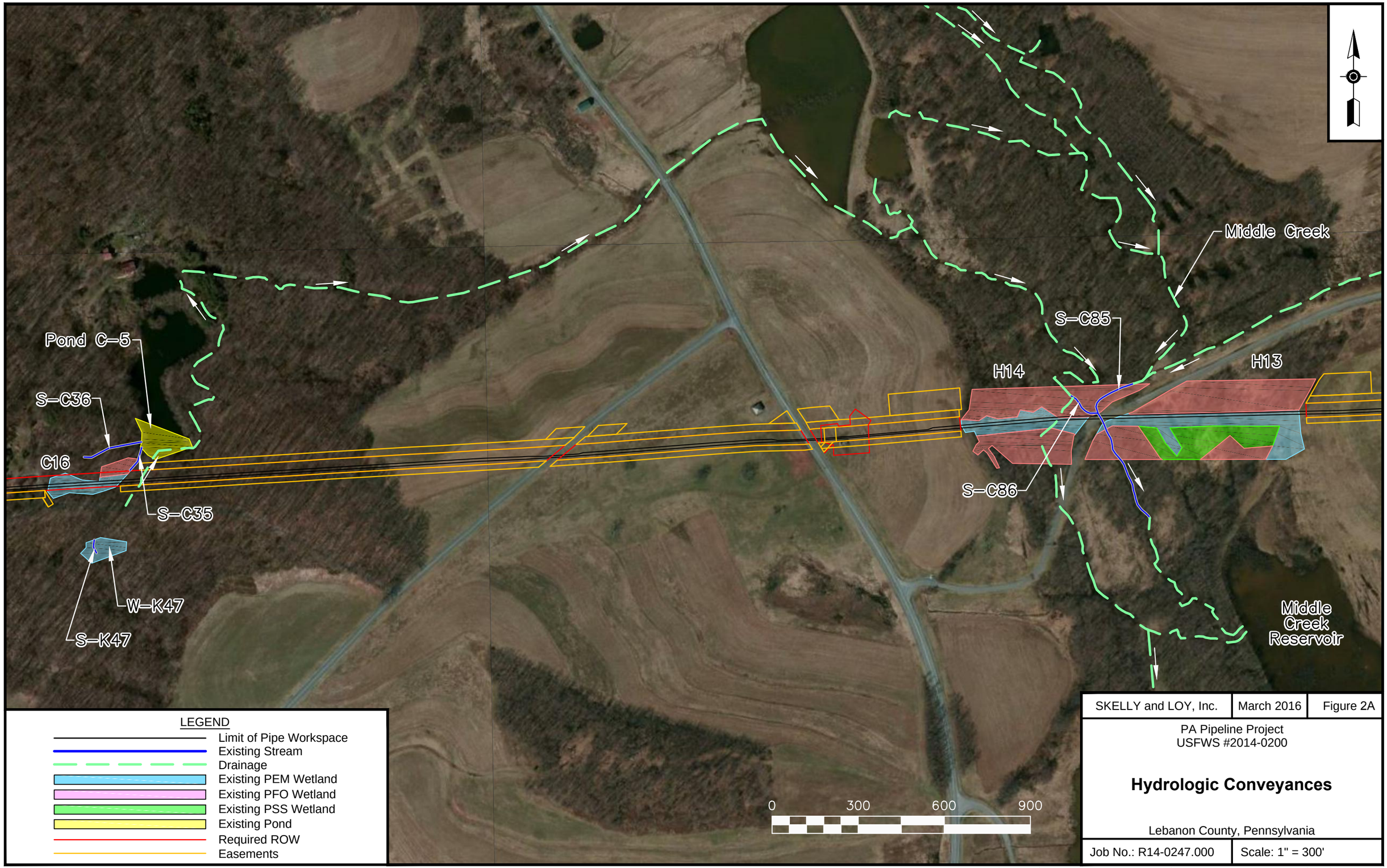
FIGURE 1D

REVISION 0

PGH P:\GIS\SUNOCO\MARINER EAST 2\MXD\PENNPIPELINE_BOGTURTLE_ADEND1.MXD 04/12/16 JN

APPENDIX E

Hydrologic Conveyance Figure Series



LEGEND

- Limit of Pipe Workspace
- Existing Stream
- Drainage
- Existing PEM Wetland
- Existing PFO Wetland
- Existing PSS Wetland
- Existing Pond
- Required ROW
- Easements

SKELLY and LOY, Inc.	March 2016	Figure 2A

PA Pipeline Project
USFWS #2014-0200

Hydrologic Conveyances

Lebanon County, Pennsylvania

Job No.: R14-0247.000	Scale: 1" = 300'

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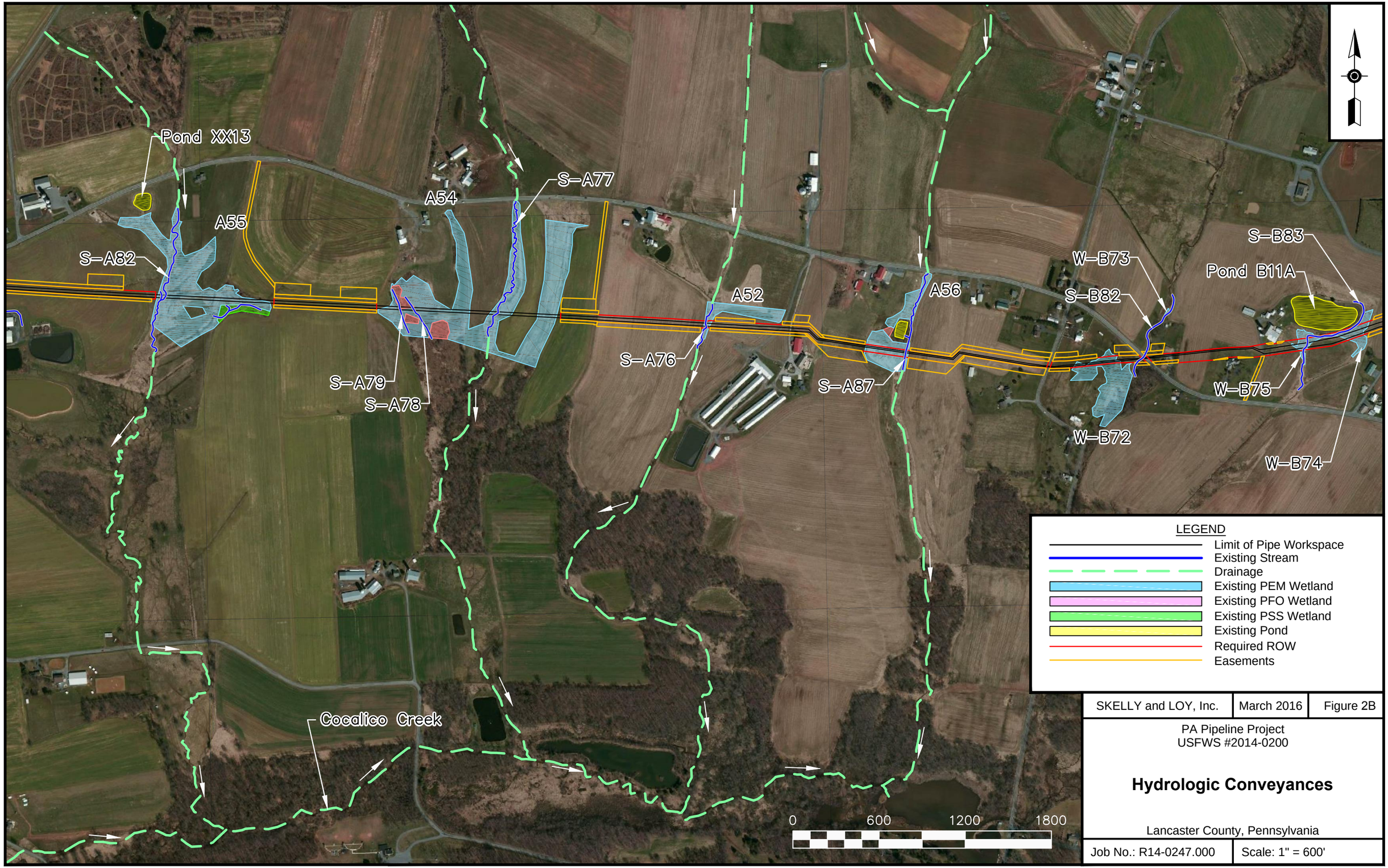

LEGEND

- Limit of Pipe Workspace
- Existing Stream
- Drainage
- Existing PEM Wetland
- Existing PFO Wetland
- Existing PSS Wetland
- Existing Pond
- Required ROW
- Easements

SKELLY and LOY, Inc.	March 2016	Figure 2B

PA Pipeline Project
USFWS #2014-0200

Hydrologic Conveyances

Lancaster County, Pennsylvania

Job No.: R14-0247.000	Scale: 1" = 600'

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W–B20
S–B18
S–B19
W–B19
Marsh Creek
W–JA3
W–H16
S–H9
W–H15

LEGEND

- Limit of Pipe Workspace
- Existing Stream
- Drainage
- Existing PEM Wetland
- Existing PFO Wetland
- Existing PSS Wetland
- Existing Pond
- Required ROW
- Easements

0 300 600 900

SKELLY and LOY, Inc.	March 2016	Figure 2C

PA Pipeline Project
USFWS #2014-0200

Hydrologic Conveyances

Chester County, Pennsylvania

Job No.: R14-0247.000	Scale: 1" = 300'

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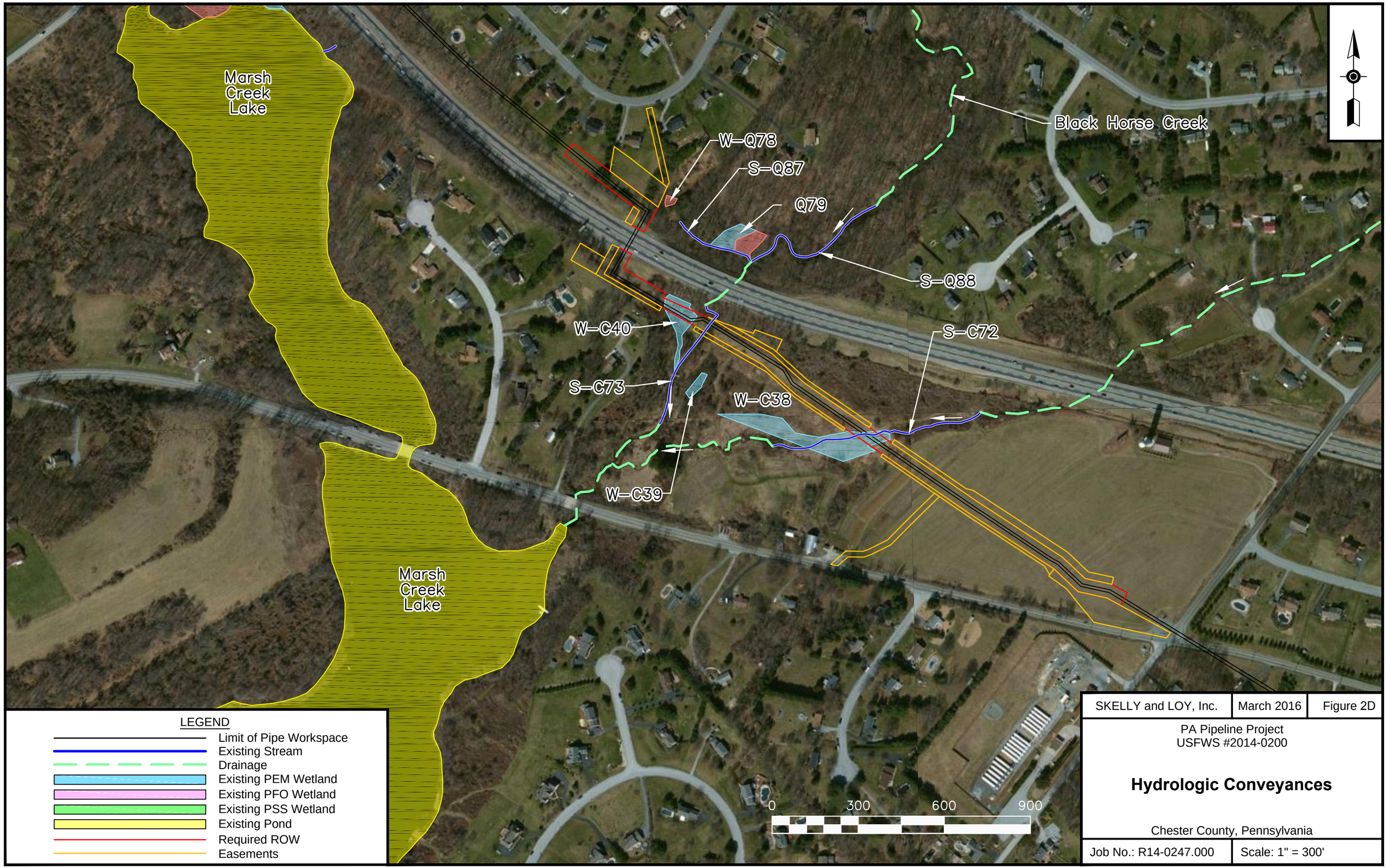

LEGEND

- Limit of Pipe Workspace
- Existing Stream
- Drainage
- Existing PEM Wetland
- Existing PFO Wetland
- Existing PSS Wetland
- Existing Pond
- Required ROW
- Easements

SKELLY and LOY, Inc.	March 2016	Figure 2D

PA Pipeline Project
USFWS #2014-0200

Hydrologic Conveyances

Chester County, Pennsylvania

Job No.: R14-0247.000	Scale: 1" = 300'

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APPENDIX F

HDD Inadvertent Return Contingency Plan with Special Bog Turtle Area Procedures

11/12/2016 Project Note: IR Plan not included due to revision. USFWS provided an updated Nov 2016 IR Plan. Always refer to the Project's most recent IR Plan.