Transcontinental Gas Pipe Line Company, LLC

Requirement S – Alternatives Analysis

Regional Energy Access Expansion Project – Effort Loop

April 2021
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ALTERNATIVE ANALYSIS

1.0 Introduction

Transcontinental Gas Pipe Line Company, LLC (Transco), indirectly owned by the Williams Companies, Inc. (Williams) is seeking authorization from the Federal Energy Regulatory Commission (FERC) under Section 7(c) of the Natural Gas Act to construct, own, operate, and maintain the proposed Project facilities associated with the Regional Energy Access Expansion Project (Project). The Project is an expansion of Transco's existing natural gas transmission system that will enable Transco to provide an incremental 829,400 dekatherms per day (Dth/d) of year-round firm transportation capacity from the Marcellus Shale production area in northeastern Pennsylvania (PA) to multiple delivery points along Transco's Leidy Line in PA, Transco's mainline at the Station 210 Zone 6 Pooling Point in Mercer County, New Jersey (NJ) and multiple delivery points in Transco's Zone 6 in NJ, PA, and Maryland. Subject to FERC's certification of the Project and receipt of the necessary permits and authorizations, Transco anticipates construction of the Project to start in second quarter 2023 to meet a proposed in-service date of fourth quarter 2024. Project components in Monroe County are limited to the 42" Effort Loop and associated valve sites and contractor yards.

The Effort Loop component of the Project will consist of approximately 13.8 miles of 42-inch pipeline co-located with existing Transco Leidy Lines between Mileposts 43.72 and 57.50 in Ross, Chestnuthill and Tunkhannock Townships, Monroe County. The new pipeline will tie-in to the existing 42-in Leidy Line "D" on both ends, completing the segment. With the segment completed, the existing pig traps (industry term for manifolds that launch or receive in-line inspection tools) at both tie-ins will no longer be needed and will therefore be removed, while the existing mainline valves will remain. Transco will be installing a new mainline valve and appurtenant equipment at Milepost 49.6 off Sugar Hollow Road. The valve installation is a means to isolate gas flows. One Contractor Yard is proposed at the east end of the pipeline at MP 43.72. One remote anode groundbed is proposed at MP 43.72.

This alternatives analysis, which solely evaluates the Project components with Chapter 105 regulated resources in Monroe County, is consistent with the requirements of 25 Pa Code Ch 105, in particular § 105.13(e)(viii), and Draft Technical Guidance Document No 310-2100-### Revised on 4/17/2020, the Federal Water Pollution Control Act (CWA) (33 U.S.C.A. §§ 1251—1388), as amended, and the Federal Energy Regulatory Commission's (FERC) regulatory requirements as set forth in 18 Code of Federal Regulations 380.15 . , In accordance with the foregoing, in particular, 25 Pa Code §105.13(e)(1)(viii), this alternatives analysis includes "[a] detailed analysis of alternatives to the proposed action, including alternative locations, routings or designs to avoid or minimize adverse environmental impacts".

2.0 No-Action Alternative

Under the No-Action Alternative, the Project would not be constructed or operated. The potential environmental impacts of construction and operation of the Project would not occur; however, this alternative would not meet the purpose and need for the Project. Under the No-Action Alternative, Transco would not be able to provide 829,400 Dth/d of firm transportation capacity from receipt points along Transco's Leidy system eastbound to existing Transco markets in PA, NJ, and MD. In addition, the No-Action Alternative would not alleviate the constrained takeaway capacity from the Marcellus production areas and support the overall reliability and diversification of energy infrastructure in the Northeast.

Transco's assessment is based, in part, on an analysis of existing Transco facilities in and near the Project area, which do not provide adequate pipeline takeaway capacity for transportation of natural gas to meet current transportation demand. The No-Action Alternative would force Transco's customers to seek other transportation services and/or depend on other future development projects with unpredictable schedules and undetermined environmental impacts. Therefore, the No-Action Alternative is not a viable alternative to the project.

3.0 System Alternatives

System alternatives are alternatives to the proposed action that would make use of other existing, modified, or proposed pipeline systems to meet the objectives of the proposed Project. A system alternative would make it unnecessary to construct all or part of the proposed Project, although some modifications or additions to another existing pipeline system may be required to increase its capacity, or another entirely new system may need to be constructed. System alternatives involving modifications or additional system facilities would also result in environmental impacts.

To be a viable system alternative to the proposed Project, potential system alternatives must meet three criteria:

- The system must be capable of transporting up to 829,400 Dth/d of natural gas to existing Transco markets in PA, NJ, and MD;

- The system alternative must be capable of transporting the required volumes within the same schedule as the proposed Project; and
- Use of an alternative system must be able to meet the criteria above and at the same time result in reduced environmental impacts when compared to the proposed Project.

3.1 Existing Pipeline System Alternatives

Transco owns and operates its Leidy Line system, Marcus Hook Lateral, Trenton Woodbury Lateral, and the Transco Mainline system within the Project area. Transco's existing systems do not have available unsubscribed capacity to service the volume under contract for the Project. Therefore, Transco's systems currently are not capable of providing an incremental 829,400 Dth/d of year-round firm transportation capacity from receipt points along Transco's Leidy system eastbound to existing Transco markets in PA, NJ, and MD. Using hydraulic modeling, Transco evaluated additional compression alternatives within the Transco system that could meet the objectives of the Effort Loop. This compression-intensive system alternatives are described in Section 3.2.

The Texas Eastern Transmission (TETCO) Pipeline System and the Columbia Gas Transmission Pipeline System have existing facilities in the vicinity of the Project delivery locations' however they do not have access to the gas source that the Project is utilizing. The Tennessee Gas Transmission System has existing facilities near the gas source of the Project; however, they do not have access to the delivery locations of the Project. For these reasons, these systems have been deemed unacceptable alternatives to the Project.

Given its proximity to the Project, Transco conducted a comparative analysis of the Project to the PennEast Pipeline Company, LLC proposed pipeline project (PennEast). Whether evaluating the PennEast project (as a whole) or PennEast Phase 1 as an independent project, Transco determined that neither would be viable alternatives to the Project. PennEast Phase 1 would only provide delivery points in PA to UGI Central Penn Gas, Inc., Columbia Gas Transmission, LLC, and Adelphia Gateway, LLC. In contrast, the Project will provide delivery points in PA, NJ, and MD, which PennEast Phase 1 would not be able to provide without significant extension of the pipeline, totaling approximately 222 miles, into NJ and MD. For these reasons, the PennEast project cannot address, nor can it be readily modified to address, the purpose and need for the Project; therefore, it is not a viable system alternative.

3.2 Compression-Intensive System Alternatives

Transco identified one compression-intensive system alternative in lieu of the Effort Loop. The compression-intensive alternative would utilize the installation of new compression, with a new compressor station, along the existing Leidy Line System to meet the Project capacity demand. Compression-intensive alternatives are typically designed to avoid stream, wetland, and forest impacts to the extent practicable. However, new compression involves permanent above ground land use impacts for the compressor station, and is a potential source of air quality and noise impacts. Loop-intensive alternatives may also have temporary, localized air and noise impacts during construction, and, depending on the length of looping required, can result in significantly greater impacts on environmental resources than a single-site compressor station, depending on a variety of factors. The compression-intensive system alternative to Effort Loop is described below.

For the compression-intensive alternative to the Effort Loop, one new compressor station with approximately 117,325 HP capacity would need to be installed in Northampton County, PA. Table 3.2-1 provides a comparison of the environmental impacts of the Project (Effort Loop) and this compression--intensive alternative. Under the compression--intensive alternative, the Regional Energy Lateral in Luzerne County and other proposed compressor station and meter station construction/modifications would still be required to meet the Project's purpose and need.

Construction of the additional new compressor station would impact approximately 54 acres during construction and up to 31 acres during operation (new permanent ROW) and would directly impact one landowner. In contrast, the proposed Effort Loop would be collocated with Transco's existing Leidy Line System ROW and would link Transco's existing Leidy Line D from MP 43.72 to MP 57.50, thereby minimizing new impacts to sensitive species, cultural resources, and previously undisturbed habitats, though approximately 163 acres would be used during construction with greater impacts to streams, wetlands, and forested areas. In addition, by collocating with Transco's existing Leidy Line System, Effort Loop would be located on and adjacent to properties with existing Transco easements. In contrast, the compression-intensive alternative would require construction of a new station at a previously undisturbed location. In addition, the operational impacts of constructing a new above-ground compressor station would include introduction of long-term air emissions and noise impacts that would require operational mitigation. The compressor station would be designed such that emissions would not cause modeled exceedances of the applicable National Ambient Air Quality Standards (NAAQS). No long-term operational impacts would be expected with operating the loop because impacts are limited to construction activities, which are considered short-term.

Looping was also determined to be preferable over compression for operational considerations. Utilizing compression in lieu of looping would result in an extremely large pressure differential across the Compressor Station that would increase the temperature of the gas; therefore, gas cooling equipment would be required, which would likely increase noise impacts. The Compression-Intensive alternative would also reduce the pressure at multiple delivery points on the suction side of the Station, which could adversely affect existing customers' ability to receive gas from Transco's system. In addition, the compression-intensive alternative would result in significantly greater fuel consumption and fuel costs, thereby reducing Transco's competitive market position.

Because of the known reliability factors for compression versus transmission lines, the proposed pipe looping would be superior from a reliability standpoint. The typical reliability/availability of compression-related equipment for the transportation of natural gas is in the range of 90% to 99%. The typical reliability/availability of pipeline assets for the transportation of natural gas is in the range of 98% to 99.5%. This is because compression facilities require more frequent routine maintenance, whereas pipelines require repairs only on an as-needed basis.

Because the Effort Loop would: (1) minimize new impacts through collocation with the existing Leidy Line system; (2) have no long-term operational air emissions and noise impacts; (3) link segments of the existing Leidy Line D; and (4) support system operational efficiency and reliability, the compression-intensive alternative was eliminated from further consideration.

Table 3.2-1
Comparison of the Environmental Impacts of Effort Loop and the Compression-Intensive Alternative

Factor	Unit	Effort Loop	Compression-Intensive Alternative
Length of pipeline	miles	13.8	N/A
Construction ROW[a]	acres	162.6	54.4
Operation ROW[a]	acres	38.2	N/A[b]
Construction impacts on forested land	acres	71.8	2.1
Operation impacts on forested land	acres	24.7	0.0
Construction impacts on wetlands (NWI)	acres	1.9	0.0
Operation impacts on wetlands (NWI)	acres	0.7	0.0
Number of waterbody crossings (NHD)	count	0	0

Table 3.2-1
Comparison of the Environmental Impacts of Effort Loop and the Compression-Intensive Alternative

Factor	Unit	Effort Loop	Compression-Intensive Alternative
Number of stream crossings (NHD)	count	4	0
Number of residences within 50 feet of the construction ROW	count	28	1
Number of landowners crossed by the construction ROW[b]	count	224	1

Sources: USFWS 2019; USGS 2019; USGS 2016

[a] Assumes a construction ROW width of 100 feet and an operational ROW of approximately 25 feet for the Effort Loop. In some areas the Effort Loop is encompassed within the existing Leidy System ROW and no additional permanent ROW is required. Estimated construction and operation workspace for the Compression-Intensive Alternative is preliminary; upon detailed design, operational footprint could be significantly reduced.
[b] Detailed station design is not available. Facility size is dependent on detail design and site conditions.
[c] Of the landowners crossed by the Loop, an estimated 61 are new impacted landowners without an existing Transco easement. The compression-intensive alternative would be located within Transco property.

Key:
N/A = not applicable/available
NHD= National Hydrography Database
NWI= National Wetlands Inventory
ROW = Right-of-way
TBD= To be determined

3.3 System Alternatives Conclusion

Using hydraulic modeling, Transco was able to evaluate where additional compression would be required to meet the purpose and need of the Project. Transco identified one compression-intensive alternative to the Effort Loop. Based on the analysis provided, this alternative would not meet the Project purpose and/or results in more environmental impacts or reduced system operational efficiency/reliability. The Effort Loop was selected in lieu of the compression alternative to: (1) minimize new impacts through collocation with the existing Leidy Line system; (2) avoid long-term operational air emissions and noise impacts ; (3) link segments of the existing Leidy Line D; and (4) support system operational efficiency and reliability.

The expansion of other existing pipeline systems in lieu of the Project would require additional pipeline as well as additional system upgrades such as added looping and/or compression. Transco believes that its Project design is more efficient than system alternatives that could be proposed to provide the same service. Since Transco can construct its facilities with construction and mitigation measures that would minimize environmental impacts such that they are less than the environmental impacts posed by system alternatives, system alternatives were not considered to be preferable to the Project.

4.0 Route Alternatives

The Effort Loop is 100% collocated within Transco's existing Leidy Line A, B, and C ROW, therefore no route alternatives or route deviations were considered or have been evaluated.

5.0 Impact Minimization of the Proposed Alternative

5.1 Pipeline Workspace

Construction of the pipeline facilities will require the acquisition of temporary construction ROWs, additional temporary workspace (ATWS), and permanent (operational) easements along the entire length of each pipeline route. Transco proposes to utilize the following nominal ROWs during construction of the pipeline facilities:

- A 100-foot-wide construction ROW for installation of the 42-inch-diameter Effort Loop.

The Effort Loop is entirely co-located with the existing Transco Leidy Line System. Transco proposes the construction ROWs to provide for safe and efficient construction of large diameter pipeline facilities in accordance with OSHA regulations (29 CFR 1926.650-1926.652, Subpart P) and Interstate Natural Gas Association of America's (INGAA's) workspace guidelines (INGAA 1999). Reductions or "neck-downs" of the construction ROW at resource crossings were employed to avoid and minimize resource impacts.

In wetlands, a nominal 75-foot-wide construction ROW will be utilized. During pipeline construction, machinery operates on one side of the trench (working side), and excavated materials is stockpiled on the other side (spoil side). Stockpiled spoils within wetlands will be placed on matting with geotextile to prevent mixing of topsoils and subsoils during construction. In some instances (smaller wetlands), excavated materials are hauled outside of the limits of the wetland and stockpiled until the pipe installation is complete. At most wetland crossings, this workspace has been necked down to 75 feet. In a reduced 75-foot-wide ROW, the proposed working side of the ROW is typically 50 feet wide.

Within the top of bank (TOB) of streams, a 50-foot-wide construction ROW will be used, and a 75-foot-wide construction ROW will be used in floodways, except where Transco has provided site-specific justification, as outlined in Table 5.1-1. At most stream crossings, this workspace has been necked down to 50 feet within the TOB and 75 feet in the floodway. Within TOB, in a reduced 50-foot-wide ROW, the proposed working side of the ROW is typically 38 feet wide and spoil side being 12 feet. Within floodways, in a reduced 75-foot-wide ROW, the proposed working side of the ROW is typically 45 feet wide.

Table 5.1-1
Site-Specific Justification for Additional Workspace

Watercourse Feature ID	Approximate Milepost	Feature Type	ROW Width	Justification
S3-5	45.8	Stream & Floodway	113 (stream) 125 (floodway)	Due to the stream being fully contained within a culvert, and the surrounding terrain being developed and commercial land. Neckdowns of workspace would not result in any change in water quality or any reduction in environmental impacts. The culvert will remain intact for the crossing.
S1-T1	48.5	Stream	53	Due to terrain considerations and being adjacent to a road crossing, the trench will become wider than normal. Additional workspace within TOB is needed to facilitate a safe and efficient watercourse crossing.
S1-T2	49.4	Stream	63	Due to adjacent saturated wetlands, steep terrain, adjacent road crossing and workspace constraints due to existing pipelines. Additional workspace within TOB is needed to facilitate a safe and efficient watercourse crossing.
S2-T1	52.6	Stream	63	Due to steep terrain and adjacent wetlands at stream crossing, which will require a wider trench to install the pipe. Additional workspace within TOB is needed to facilitate a safe and efficient watercourse crossing.
S5-T2	53.6	Stream	63	Due to saturated wetlands on both sides of stream, ditch will become wider than normal. Additional workspace within TOB is needed to facilitate a safe and efficient watercourse crossing.

These wetland, stream, and floodway workspace neck downs are the most reasonable neck downs for pipeline installation within these resources, as it will still allow for required workspace to complete the construction activities while minimizing environmental impacts. These reductions to the workspace are considered the maximum reductions for the safe operation and passage of equipment and personnel while minimizing the length of time required to cross the features.

5.1.1 Construction Technique Alternatives

Transco evaluated the feasibility of implementing trenchless construction techniques to cross sensitive areas. These techniques may be used in an attempt to reduce impacts associated with construction in comparison with using conventional (trenching) construction techniques. While use of trenchless methods can reduce impacts on or avoid sensitive areas, these methods have limitations that must be considered before a method is selected as the proposed construction method for a given crossing. The following sections outline the factors that will be evaluated when selecting the proposed construction method for a given crossing.

5.1.1.1 Trenchless Analysis

A trenchless analysis was conducted for wetland and stream crossings to determine if either a conventional bore (bore) or a horizontal directional drill (HDD) would be a feasible construction technique for the resource crossing. If a particular technique was considered potentially feasible, the crossing was further assessed to confirm that the trenchless installation would have less impact than a dry-ditch open cut crossing. Finally, for those trenchless crossings that were both feasible and minimized impacts, field assessments including geotechnical borings were completed to confirm suitable conditions for executing the trenchless crossing.

Each crossing was first assessed to determine if a conventional bore would be a suitable construction method. If a conventional bore would be practical, a review for HDD suitability was not completed. Conversely, if a conventional bore crossing was not suitable for a given resource, an assessment was completed to determine if an HDD would be a suitable construction method. Should neither trenchless method be suitable, a dry-open cut methodology would be utilized. Below is a summary of the trenchless analysis for conventional bore and HDD. Appendix S-1 includes a flow chart that was utilized during the trenchless analysis.

Conventional Bore Analysis

A conventional bore trenchless analysis was not completed for wetland resources as outlined in Appendix S-1. Typically, a conventional bore is not a practical crossing method for a wetland due to the augmented upland workspace requirements and relatively short crossing length capabilities of a conventional bore, typically limited to 300 feet. In addition, not all impacts to the resource are completely avoided with a conventional bore, as a 10-foot corridor is maintained as emergent cover to allow for pipeline inspection, and a travel lane through the resource could be required during construction. However, where certain infrastructure crossings require a conventional bore, adjacent wetlands may be incorporated where practicable.

Where topographic and geologic conditions allow, a conventional bore can be a practical method for mitigating impacts to streams. Streams were evaluated in a phased approach, as shown in Appendix S-1. Phase I of the stream assessment is a topography evaluation that considers the bore length, pit depth, and proximity to adjacent infrastructure, such as roads. As previously noted, the typical maximum length for a standard conventional bore is 300 feet. Beyond 300 feet, alignment risks related to steering difficulties are introduced; therefore, bores exceeding 300 feet in length are avoided where possible. The bore pit depth is evaluated to ensure constructability. If the bore pit exceeds 20 feet in depth, standard trench boxes are not tall enough to maintain the integrity of the bore pit walls, and benching and spoil storage are required, necessitating a significantly larger workspace. Therefore, conventional bores are avoided when the depth of the bore pit exceeds 20 feet, where possible.

If a feature is in the immediate vicinity of existing infrastructure, such as roadways that are proposed for boring, a conventional bore may be considered appropriate for crossing both the resource and the roadway. The construction method can be completed for both crossings (stream and/or wetland and infrastructure) as the boring can capture both features within the same bore, given their close proximity.

If a stream was able to be bored based on the general parameters outlined in Phase I, or if a stream was required to be bored due to adjacent infrastructure, the Phase II evaluation was completed. The Phase II evaluation is broken into two categories that consider impacts and risk.

Phase II-A of the analysis includes an impacts assessment of the following items related to workspace required for the conventional bore:

- Impacted wetlands
  - PFO
  - PEM
  - PSS
- Impacted uplands
- Land Use
- Noise generated by construction equipment
- Anticipated construction durations

- Phase II-B included a risk assessment for the completion of the conventional bore. The assessment provides a desktop analysis of the following risk factors:

- Site Constraints
- Bedrock quality
- Blasting for bore pits
- Soil conditions
- Soil/rock interface
- Karst

If Phase II found a stream to be suitable for boring, the Phase III evaluation was completed. Phase III was an evaluation of subsurface conditions, by means of geotechnical borings, to determine if a conventional bore was feasible. A conventional bore may be considered infeasible due to various reasons including the limitations of equipment used for conventional bore, risk due to subsurface conditions, or other construction related concerns.

For the Effort Loop, none of the streams were deemed feasible to be crossed by a conventional bore. Most of the streams are either within wetlands, causing the crossing length to exceed 300 feet, or they have terrain considerations that cause bore pit depths to be in excess of 20 feet. One wetland will be conventionally bored (W1-T2) as it is adjacent to a state highway that requires a trenchless crossing.

The remaining streams and wetlands on the Project were deemed not feasible as conventional bores and moved on to the HDD assessment.

<u>Horizontal Directional Drilling Analysis</u>

Phase I of the wetland HDD assessment involved reviewing the feature characteristics of the wetland and the total acreage of impacted PFO wetland. For a wetland to be considered for an HDD crossing, it must be classified as Exceptional Value (EV) in 25 PA Code Chapter 105.17. Due to the temporary nature of impacts, wetlands not classified as EV were not considered in Phase I of the Trenchless assessment. If PFO wetland impacts are less than one acre, Transco considers open cut construction methods a better option than an HDD for minimizing overall impacts. Crossings with PFO wetland impacts exceeding one acre moved on to Phase III of the assessment (there is no Phase II assessment for wetlands), and potential HDD workspace was developed. Wetlands designated either PEM or PSS were not considered for an HDD crossing as no vegetative cover type change occurs in PEM wetlands and minimal changes occur in PSS wetlands; only a 10-foot corridor is maintained as emergent cover to allow for pipeline inspection.

Phase I of the stream assessment involved a feature characteristic review of the streams crossed by the proposed pipeline. Streams located within special protection watersheds were identified for Phase II consideration. Phase II of the stream assessment considered the width of the streams that passed the Phase I review. For streams greater than 30 feet in width, a proposed workspace was developed for Phase III consideration. Smaller streams were not identified for Phase III consideration because the risks and impacts (i.e. workspace requirements, noise) associated with an HDD crossing categorically outweigh the benefits. The dry-open cut methodology is appropriate for smaller streams because it minimizes crossing time and avoids the risk of an inadvertent return.

Phase III of the analysis was the same for both wetlands and streams. The Phase III evaluation was broken into two categories that evaluate risk and impacts.

Phase III-A of the analysis included an impacts assessment of the following items related to workspace required for the HDD:

- Impacted Wetlands
  - PFO
  - PEM
  - PSS
- Impacted Uplands
- Land Use
- Water Consumption
- Noise generated by construction equipment
- Air emissions generated by construction equipment
- Anticipated construction durations

Phase III-B included a risk assessment for the completion of the HDD. The assessment provides an analysis of the following risk factors:

- Site Constraints and Topographic Considerations
- Elevation Differential and Dry Hole
- Hole Stability
- Obstructions
- Pilot Hole Steering
- Drilling Fluid Loss, Hydraulic Fracture and Inadvertent Returns
- Poor Cuttings Removal

- Hole Obstructions and Flushing
- Downhole Tooling Failure/Loss
- Time of Installation

Phase IV of the HDD evaluation involves field work to gather geotechnical borings. The geotechnical bores are evaluated to determine if subsurface conditions are conducive for a successful HDD. An HDD may not be considered feasible where subsurface conditions present the potential for significant construction risks.

No wetlands continued past Phase I of the HDD assessment as none had PFO impacts greater than one acre. However, during the pre-application process, DEP identified one large wetland complex (W4-T1, W3-T1) on the Effort Loop to be reviewed as a trenchless crossing.

Based on the Phase III assessment, the large wetland complex (W4-T1, W3-T1) HDD crossing was not considered feasible due to the desktop geologic subsurface conditions, as outlined in Appendix S-2 Trenchless Analysis Feasibility Study. This crossing location is not identified for Phase IV consideration.

One wetland is proposed as a conventional bore crossing, as it relates to its proximity to adjacent infrastructure, State Route 715 (W2-T2). Appendix S-3 includes a soil boring report for the crossing.

Based on the Phase II stream assessment, UNT to Poplar Creek (Effort S2-T1) was identified for Phase III consideration. The Phase III assessment for the UNT to Poplar Creek (S2-T1) indicated that site conditions would not support an HDD alignment. An HDD at this crossing location would be extremely long or have entry/exit angles at 20° or more. The UNT to Poplar Creek (S2-T1) HDD crossing was not considered feasible and was not identified for Phase IV consideration.

6.0 Summary

An alternatives analysis has been prepared for the proposed Project, consistent with the requirements of PA Code 105.13(e)(vii). The alternatives analysis has taken a multi-tier approach, first looking at the system alternatives for Project design options, and then taking the selected system design and evaluating the alternatives, avoidance and minimization measures, and construction techniques associated with the proposed alternative design. The Project as proposed has minimized impacts to environmental resources, while meeting the Project goals. Construction measures and methods were thoroughly evaluated to minimize effects to environmental resources, including streams and wetlands. The Project is considered water dependent, as it requires siting within water to fulfill the basic purposes of the Project, as defined by PA Code 105.13(e)(x)(C). Based upon the results of the analysis, the proposed Project meets the Project goals and is consistent with state antidegradation requirements.

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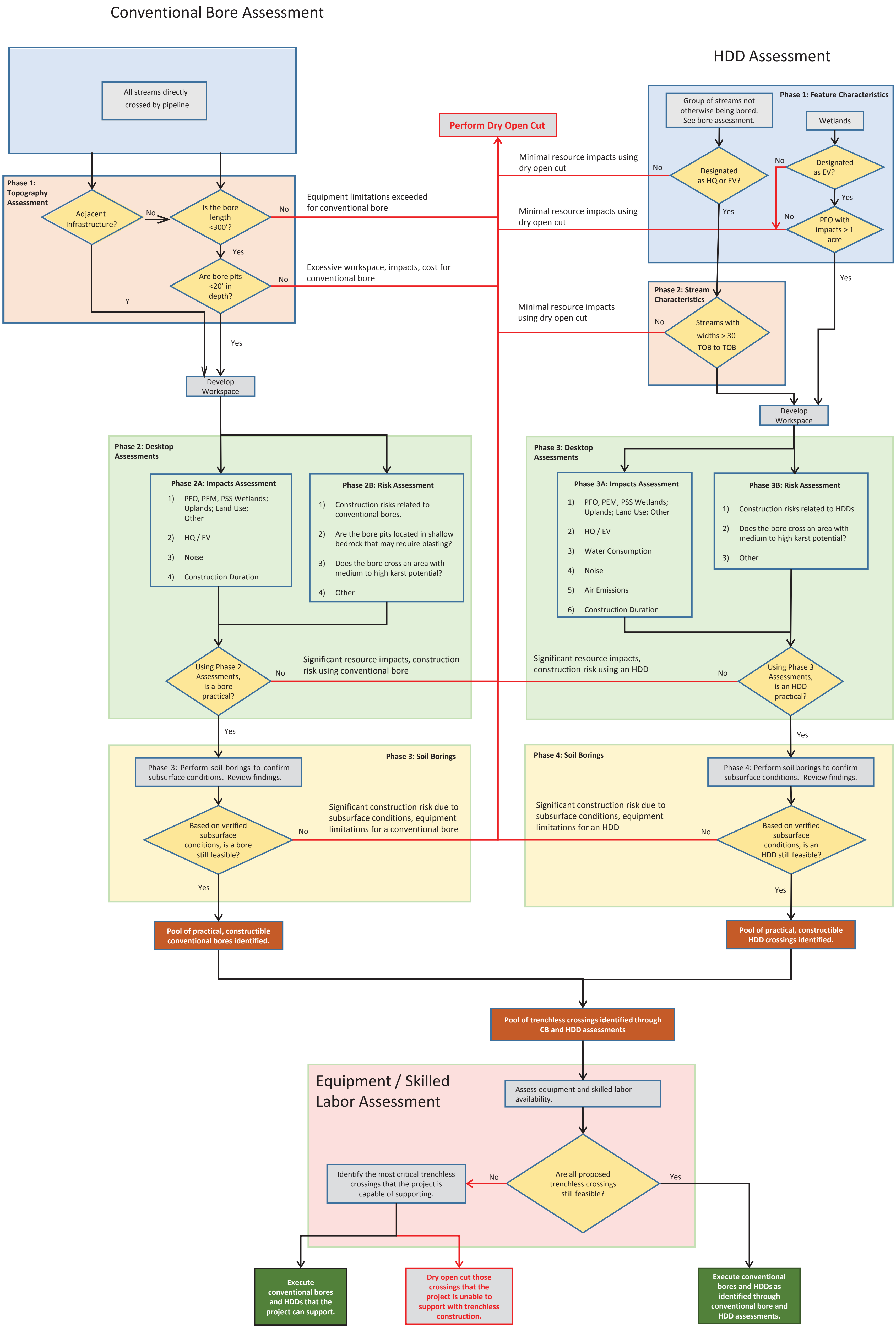
APPENDIX S-1

TRENCHLESS ANALYSIS FLOWCHART

03/10/2021

Regional Energy Access Expansion Project
Trenchless Analysis Flow Chart



APPENDIX S-2

PRELIMINARY TRENCHLESS CROSSING DESKTOP STUDY – WETLANDS (W4-T1, W3-T1)

Preliminary Trenchless Crossing Desktop Study

Regional Energy Access Effort Loop – Wetland HDD

Williams Project Execution – Transmission & Gulf of Mexico
December 15, 2020

Prepared By: Brian E. Halchak
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Project Description

The Regional Energy Access Expansion (REAE) project is proposed to add capacity to the existing Transcontinental Gas Pipe Line System (Transco). A portion of this project includes the 42-inch Effort Loop situated in Monroe County, Pennsylvania. The west end of the Effort Loop crosses a wetland complex near the Pocono Raceway, and as part of an effort to reduce environmental impacts in this area, Williams evaluated a horizontal directional drill (HDD) for this crossing. This report evaluates the proposed crossing of the wetland complex for trenchless feasibility and practicality using a variety of public data sources.

Figure 1: Effort Loop Pipeline Route

Effort Loop Wetland HDD Geology Data

According to the Natural Resources Conservation Service (NRCS) web soil survey, the following soil types are identified to be within the area of the proposed HDD.

Monroe County, Pennsylvania (PA089)

Map Unit Symbol	**Map Unit Name**	**Acres**	**Percent**
AwB	Alvira and Watson very stony loams, 0 to 12 percent slopes	1.1	0.5%
BxB	Buchanan extremely stony loam, 0 to 8 percent slopes	102.7	49.1%
CxB	Clymer extremely stony loam, 0 to 8 percent slopes	92.5	44.3%
DxB	Dekalb channery loam, 0 to 8 percent slopes, rubbly	8.4	4.0%
DxC	Dekalb very channery loam, 8 to 25 percent slopes, extremely stony	0.2	0.1%
SpB	Shelmadine very stony silt loam, 0 to 8 percent slopes	4.1	1.9%
Totals for Area of Interest		208.9	100.0%

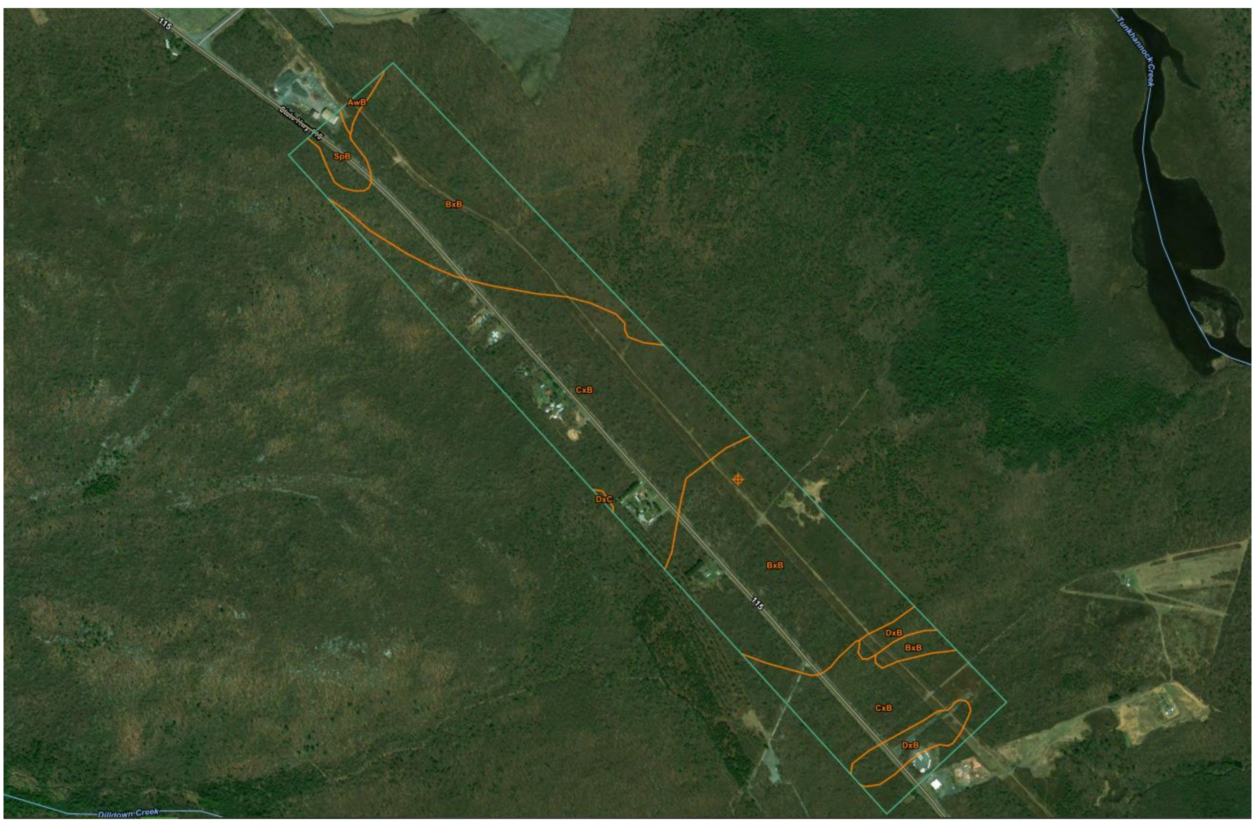

Figure 2: NRCS Web Soil Survey Area of Interest (AOI)

Detailed descriptions of these soil types can be found in APPENDIX A. As shown, these soil types identify areas of gravel, cobbles, stones, and boulders which can cause major issues in HDD construction. Gravel and larger sized cobbles/boulders increase the risk of inadvertent returns and hole instability. These materials can also cause problems with HDD steering during pilot hole operations increasing the risk of misalignment and the drill path exceeding tolerance zones.

The United State Geological Survey (USGS) specifies that the bedrock formation in this area is the Poplar Gap Member of the Catskill Formation. This formation is typically known to be primarily siltstone and sandstone with interbedded shale pockets. The depth to the bedrock is currently unknown at this time as the USGS did not have any available public data on bedrock depth.

This location is also identified to be within the Late Wisconsinan Glacial Border in Pennsylvania, suggesting that there is a high likelihood of encountering glacial till material. Glacial till is known to be quite variable in content also containing varying amounts of gravels cobbles and boulders.

Karst Features

According to the PA USGS public data, the closest identified karst feature is approximately 20 miles from the HDD location. This feature is an identified surface depression at approximate location 40°44'26.88"N, 75°26'52.44"W. Therefore, karst is not likely to be located within the area of this HDD but could impact the feasibility of this method if found.

Effort Loop Wetland HDD Mining Data

Mining Activity

According to available public data from the USGS, the closest coal field is the Eastern Middle Anthracite Coal Field, approximately 14 miles away. According to the WPA Brookville Raster Catalog, the entire location has been mined. There is no public data indicating coal mining activity in the vicnity of the subject wetland complex. These mine maps can be found at the following web addresses:

- ftp://data1.commons.psu.edu/pub/minemaps/Map_Repository/DEP_Pottsville/SID_Images/geor_BMSA_0860.zip

Water Well Data

Although there was no public data found in regard to public water wells within the vicinity of the HDD, Transco is aware of wells maintained by the Pocono Raceway. There are residential developments in the area, but none within 1,000 ft of a possible HDD alignment.

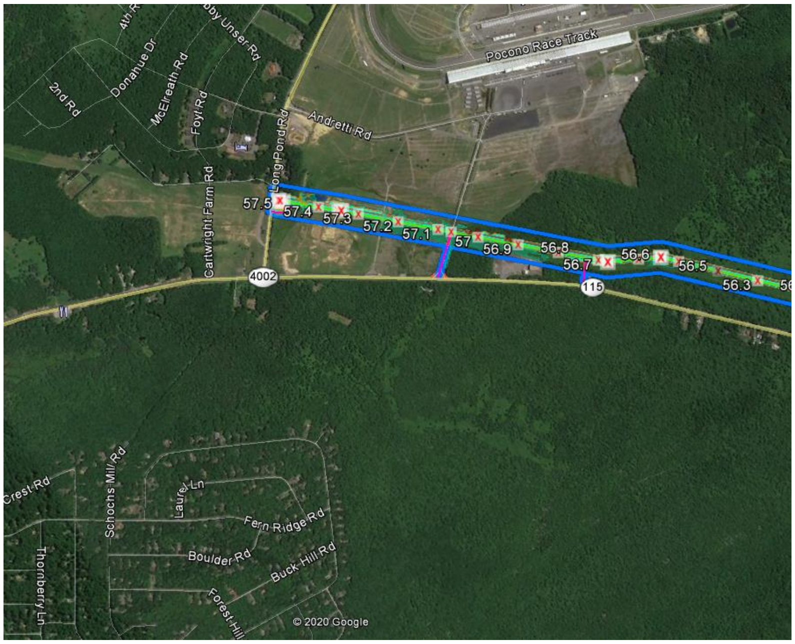

Figure 3: Residential Areas - Water Wells Likely

Preliminary HDD Geometry

A preliminary HDD alignment and profile was generated with the existing ground elevation data to get a better understanding of the geometric feasibility for an HDD at this location. The HDD would go through soils consisting mostly of glacial till with interbedded gravel, cobbles, and boulders. This will likely cause hole instability and increase the risk of inadvertent returns as previously mentioned above in the geology section of this report. Since the HDD would have to go through these high-risk areas near entry and exit, where there is less overburden to oppose fluid pressures, the chance of inadvertent returns and/or hydraulic fracture increases even more. Overall, the geometry is feasible, but the geology presents unacceptable risks during construction. Please see APPENDIX B for the HDD drawings.

Other Impacts

An HDD crossing would require approximately xxxx gallons of water for consumptive use – the creation of drilling mud. As there are no readily available water sources nearby, all water would need to be trucked in and stored in frac tanks.

Regarding threatened and endangered plant species, Showy Goldenrod and Blunt Managrass are both present in the area. They would largely be avoided with an HDD.

Conclusion

Due to the geologic and geotechnical conditions near the Pocono Raceway, an HDD at this location is not recommended. The prevalence of glacial till deposits in the area can contribute to hole instability, drill bit steering issues, hydraulic fracture, and inadvertent returns, ultimately putting the HDD at risk for failure. Furthermore, known karst features have been identified within a 20 mile range of this location, making it possible to come across karst during an HDD as well. Due to these risks, Williams believes that an open cut crossing of the wetland is the most environmentally responsible construction method for this crossing.

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APPENDIX A: Effort Loop Wetland HDD Soil Descriptions

Alvira and Watson Very Stony Loams:

Alvira Typical profile

- H1 - 0 to 10 inches: gravelly loam
- H2 - 10 to 21 inches: gravelly silt loam
- H3 - 21 to 60 inches: very gravelly silt loam

Properties and qualities

- Slope: 0 to 12 percent
- Surface area covered with cobbles, stones or boulders: 1.6 percent
- Depth to restrictive feature: 15 to 28 inches to fragipan
- Drainage class: Somewhat poorly drained
- Runoff class: Very high
- Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
- Depth to water table: About 6 to 18 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Available water capacity: Low (about 3.4 inches)

Watson Typical profile

- H1 - 0 to 10 inches: gravelly loam
- H2 - 10 to 27 inches: gravelly silty clay loam
- H3 - 27 to 60 inches: gravelly clay loam

Properties and qualities

- Slope: 0 to 12 percent
- Surface area covered with cobbles, stones or boulders: 1.6 percent
- Depth to restrictive feature: 18 to 32 inches to fragipan
- Drainage class: Moderately well drained
- Runoff class: Very high
- Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
- Depth to water table: About 18 to 36 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Available water capacity: Low (about 3.9 inches)

Buchanan Extremely Stony Loam

Typical profile

- H1 - 0 to 4 inches: channery loam
- H2 - 4 to 25 inches: gravelly loam
- H3 - 25 to 60 inches: gravelly loam

Properties and qualities

- Slope: 0 to 8 percent
- Surface area covered with cobbles, stones or boulders: 15.0 percent
- Depth to restrictive feature: 20 to 36 inches to fragipan
- Drainage class: Moderately well drained
- Runoff class: High
- Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
- Depth to water table: About 18 to 36 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Available water capacity: Low (about 3.3 inches)

Clymer Extremely Stony Loam

Typical profile

- H1 - 0 to 9 inches: very channery loam
- H2 - 9 to 49 inches: loam
- H3 - 49 to 72 inches: channery clay loam

Properties and qualities

- Slope: 0 to 8 percent
- Surface area covered with cobbles, stones or boulders: 9.0 percent
- Depth to restrictive feature: More than 80 inches
- Drainage class: Well drained
- Runoff class: Low
- Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
- Depth to water table: More than 80 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Available water capacity: Moderate (about 6.2 inches)

Dekalb Channery Loam

Typical profile

- Oa - 0 to 1 inches: highly decomposed plant material
- A - 1 to 4 inches: channery loam
- E - 4 to 6 inches: very channery sandy loam
- Bw - 6 to 19 inches: very channery loam
- C - 19 to 24 inches: extremely channery sandy loam
- R - 24 to 34 inches: bedrock

Properties and qualities

- Slope: 0 to 8 percent
- Surface area covered with cobbles, stones or boulders: 25.0 percent
- Depth to restrictive feature: 20 to 32 inches to lithic bedrock
- Drainage class: Somewhat excessively drained
- Runoff class: Very low
- Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
- Depth to water table: More than 80 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Available water capacity: Very low (about 2.4 inches)

Dekalb Very Channery Loam

Typical profile

- Oi - 0 to 1 inches: slightly decomposed plant material
- A - 1 to 4 inches: very channery loam
- E - 4 to 7 inches: very channery loam
- Bw - 7 to 26 inches: very channery sandy loam
- C - 26 to 34 inches: extremely channery sandy loam
- R - 34 to 44 inches: bedrock

Properties and qualities

- Slope: 8 to 25 percent
- Surface area covered with cobbles, stones or boulders: 9.0 percent
- Depth to restrictive feature: 20 to 40 inches to lithic bedrock
- Drainage class: Well drained
- Runoff class: Medium
- Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
- Depth to water table: More than 80 inches
- Frequency of flooding: None
- Frequency of ponding: None
- Available water capacity: Low (about 3.2 inches)

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Shelmadine Very Stony Silt Loam

Typical profile

- H1 - 0 to 7 inches: channery silt loam
- H2 - 7 to 24 inches: silty clay loam
- H3 - 24 to 50 inches: channery loam
- H4 - 50 to 70 inches: channery loam

Properties and qualities

- Slope: 0 to 3 percent
- Surface area covered with cobbles, stones or boulders: 1.6 percent
- Depth to restrictive feature: 18 to 30 inches to fragipan
- Drainage class: Poorly drained
- Runoff class: Very high
- Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
- Depth to water table: About 0 to 6 inches
- Frequency of flooding: None
- Frequency of ponding: None

Available water capacity: Low (about 3.1 inches)

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APPENDIX B: Effort Loop Wetland HDD Preliminary Geometric Design

DIRECTIONAL DRILL DATA

DESCRIPTION	STATION (FT)	ELEVATION (FT)
ENTRY @ 12°	10+00.00	0.00
PC 1	12+28.98	-48.67
PT 1	21+02.22	-140.45
PC 2	25+24.21	-140.45
PT 2	31+08.74	-99.58
EXIT @ 8°	42+81.74	65.40
HORIZONTAL LENGTH = 3281.74 FT		
DIRECTIONAL DRILL LENGTH = 3306.71 FT		

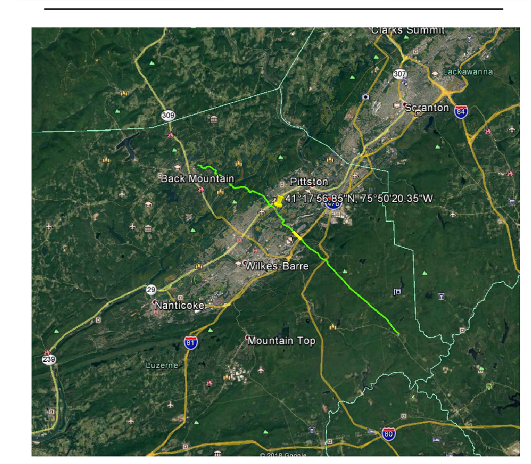
NOTES

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

LEGEND

- PROPOSED HDD PATH
- PROPOSED EFFORT LOOP
- ESTIMATED GROUND SURFACE
- WETLAND

PROJECT LOCATION



The Williams Companies, Inc.
Transcontinental Gas Pipeline Company
2800 Post Oak Blvd.
Houston, TX 77056

Williams

Regional Energy Access Pipeline
42" Diameter Effort Loop Wetland HDD Preliminary
Trenchless Feasibility Study Drawing
Luzerne County, PA

DRAWN BY: BRIAN E. HALCHAK	D-001 REV. (0)
DATE:	SHEET 1 OF 2
REA_EffortWetlandHDD_PreliminaryTrenchless	Coordinate System: NAD 1983 Pennsylvania North

DIRECTIONAL DRILL DATA

DESCRIPTION	STATION (FT)	ELEVATION (FT)
ENTRY @ 12°	10+00.00	0.00
PC 1	12+28.98	-48.67
PT 1	21+02.22	-140.45
PC 2	25+24.21	-140.45
PT 2	31+08.74	-99.58
EXIT @ 8°	42+81.74	65.40
HORIZONTAL LENGTH = 3281.74 FT		
DIRECTIONAL DRILL LENGTH = 3306.71 FT		

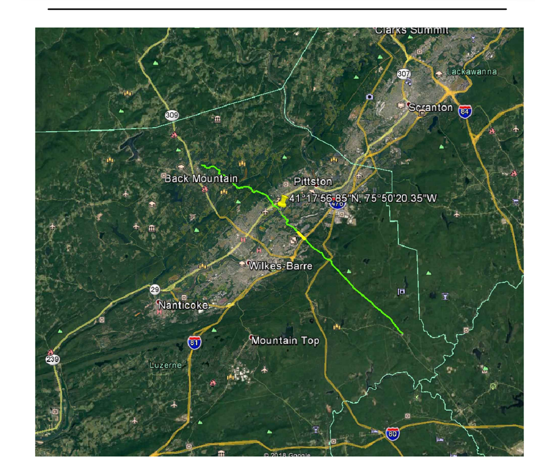
NOTES

ISSUED FOR REVIEW
NOT FOR CONSTRUCTION

LEGEND

- PROPOSED HDD PATH
- PROPOSED HDD PATH ALT
- ESTIMATED GROUND SURFACE
- WETLAND

PROJECT LOCATION



The Williams Companies, Inc.
Transcontinental Gas Pipeline Company
2800 Post Oak Blvd.
Houston, TX 77056

Regional Energy Access Pipeline

30" Diameter Effort Loop Wetland HDD Preliminary Trenchless Feasibility Study Drawing

Luzerne County, PA

DRAWN BY: BRIAN E. HALCHAK	D-001 REV. (0)
DATE:	SHEET 2 OF 2
REA_EffortLoopWetland_PreliminaryTrenchless	Coordinate System: NAD 1983 Pennsylvania North

APPENDIX S-3

SR 715 Resource Crossing Boring Report

February 23, 2022

Mr. Brett Becker
Transcontinental Gas Pipe Line Company, LLC
2800 Post Oak Blvd.
Houston, TX 77056

Dear Mr. Becker:

Subject: Geotechnical Investigation and Letter Report
Regional Energy Access Pipeline Project
Effort Loop - SR 715 Resource Crossing
Chestnuthill Township, Monroe County, Pennsylvania
CEC Project 305-105.1000

Civil & Environmental Consultants, Inc. (CEC) presents this geotechnical letter report for the proposed 42-inch Effort Loop pipeline in Monroe County, Pennsylvania. The aforementioned pipeline is part of the Regional Energy Access Project. Conventional bore methods are being considered for the pipeline installation at the wetland crossing along the proposed alignment. This geotechnical investigation was performed and this letter report was prepared in general accordance with CEC's Proposal for Geotechnical Engineering Services dated January 29, 2021. CEC received authorization from Williams Midstream Services, LLC (Williams) prior to providing geotechnical services.

This letter report outlines CEC's opinions on the soil, bedrock, and groundwater conditions at the test boring locations. Attachments to this letter report include a document titled Important Information about This Geotechnical Engineering Report, boring location plan, geotechnical cross section, test boring logs, and laboratory testing results.

1.0 GENERAL INFORMATION

Williams plans to utilize conventional horizontal boring methods to install approximately 230 linear feet of 42-inch diameter steel pipe beneath State Road 715 in Chestnuthill Township, Monroe County, Pennsylvania. The existing topography at the entry points is nearly flat, ranging from Elevation 764 to Elevation 768.

Topographical features with respect to the anticipated pipeline alignment are shown on Drawing GT01 located in Attachment B.

2.0 LITERATURE RESEARCH

2.1 Site Soils

The USDA web soil survey indicates the soils at the anticipated crossing location belong to the Braceville gravelly loam and Wyoming gravelly sandy loam soil series. These series consist of gravelly sandy loam derived from glacial outwash.

The Pennsylvania Department of Environmental Resources Map 64 "Surficial Materials of Pennsylvania" shows sandy to silty glacial diamict soils (unsorted glacial till comprised of deposits of silt, sand, gravel, and boulders) are present at the anticipated conventional bore entry/exit locations. Sandy to silty glacial diamict has variable amounts of sand and silt in the matrix with small amounts of clay. Diamict generally has moderate weathering, moderately thick soil development, and has been moderately to severely eroded.

2.2 General Geology

The USGS online spatial database shows the site bedrock is of the Marcellus Formation of the Devonian Age. Bedrock in this group consists of black shale with sparse marine fauna and siderite concretions. The Marcellus Formation also contains the Purcell limestone member. The base of this formation is the Tioga bentonite in eastern Pennsylvania.

2.3 Mining Conditions

The PADEP online coal mapping application indicates that neither deep nor surface mining has occurred at or beneath site limits.

3.0 SUBSURFACE INVESTIGATION AND TESTING

3.1 Subsurface Investigation

TBS drilled two (2) test borings, designated SB-715-01 and SB-715-02, along the proposed pipeline alignment between April 8 and April 13, 2021. Test boring depths ranged from 29.2 to 30.0 feet bgs. A total of 59.2 feet of soil was sampled as part of the investigation. The locations of the borings are shown on Drawing GT01 included in Attachment B.

The test borings were generally advanced through the soil zone using hollow stem auger drilling methods. The soil zone was sampled at 3-foot centers using a split-spoon sampler and standard penetration tests (SPT). The details of the SPT are described in the American Society for Testing and Materials (ASTM) D1586. A split-spoon sampler is a 2-inch outside diameter (OD) tube which is driven into the soil, and can be split-open lengthwise for easy removal and visual identification of the soil obtained. CEC's project representative described the soil color, texture, apparent origin, apparent moisture content, and relative density or consistency of the split-spoon samples obtained during drilling. All test borings were advanced to refusal on bedrock. CEC defines refusal as the depth at which 50 blows or more are required to drive the sampling spoon 6 inches or less, or when advancement of the auger can no longer be achieved.

Detailed soil descriptions, and other pertinent geotechnical information, including pocket penetrometer test results, are presented on the computer-generated test boring logs included in Attachment C. A summary of the definitions of standard terms and symbols used in this report is also included in Attachment C.

3.2 Laboratory Testing Program

Laboratory tests were conducted on representative samples obtained from the borings by GTS. The laboratory testing program consisted of grain size distribution, Atterberg limits (plasticity), and moisture content, of select soil samples. The soil classification test results are included in Attachment D.

4.0 SUBSURFACE CONDITIONS ALONG PROPOSED ALIGNMENT

A detailed subsurface profile depicting the materials encountered in the test borings is presented on Drawing GT01 in Attachment B. The conditions described herein represent the conditions at the test boring locations and at the time of drilling. Conditions may vary at the site at different times and locations.

4.1 Topsoil Conditions

Topsoil is defined as surficial soil supporting vegetative growth with elevated concentrations (typically exceeding about 10%) of organic material. Up to approximately 4 inches of topsoil was encountered at the test boring locations. Topsoil thickness at other locations may vary. The topsoil thickness encountered at the test boring locations was based on observations/measurements performed by CEC personnel at the time of drilling and may be interpreted differently by others. Topsoil is generally compressible and contains organic materials that decompose over time. Testing the topsoil for fertility or landscaping suitability was beyond the scope of this investigation.

4.2 Glacial Till Conditions

Glacial till was encountered in both test borings directly beneath the topsoil. The glacial till consisted primarily of gravel with varying amounts of sand, silt, and clay. The upper 3 to 6 feet of glacial till was primarily clay, transitioning to gravel below these depths. The stiffness of the fine-grained soil ranged from medium stiff to stiff and the relative density of the coarse-grained soil ranged from medium to very dense. Split-spoon refusal was encountered at several sample intervals within the glacial till zone, most likely the result of impacting a large cobble or due to the overall density of the glacial till matrix. NQ coring techniques were utilized to advance through zone of assumed boulders or cobbles where soil augers were unable to penetrate between approximately 16.3 to 21.8 feet bgs.

Laboratory testing was conducted on two samples of soil obtained from Test Boring Borings SB-715-01 and SB-715-02. The specimens were comprised of SPT samples collected during the test drilling. The soil classified as silty sand with gravel (GM) and silty gravel with sand (GW-GC) according to the USCS. The percentage of fines ranged from 10.6 to 14.3 percent and had a natural moisture contents ranging from 8.9 to 9.4 percent. The sample from SB-715-01 classified as non-plastic from the Atterberg limits testing; however, the sample from SB-715-02 had a liquid limit of 31 and a plastic limit of 22. Atterberg limits testing was performed only on the portion of the sample passing the #40 sieve.

4.3 Groundwater Conditions

Groundwater was not encountered at the completion of soil sampling in either of the test borings. Ground water levels may vary seasonally and based on several factors. Due to the proximity of an existing wetland ground water is anticipated to be encountered during conventional bore construction. If groundwater is encountered during site excavations, it can likely be controlled using standard drainage measures such as diversion ditches, pumps, and/or subsurface drains.

5.0 SPECIAL CONCERNS AND POTENTIAL ADVERSE CONDITIONS

5.1 Conventional Horizontal Bore Construction

The soils encountered in in the vicinity of the proposed crossings were primarily coarse-grained, but fine-grained soils were also encountered in the test borings. Coarse-grained soils are generally not cohesive and can contribute to borehole instability. Temporary casing or other means may be necessary to ensure borehole stability at the bore/receiving locations where coarse grained soils and fill are present.

5.2 Temporary Excavations

Temporary excavations at the bore entry and exit pits will encounter soils classified by the Occupational Health and Safety and Health Administration (OSHA) as Type B and/or Type C soils. Excavation slopes should be flattened or shored to prevent instability and to limit soils from raveling or sloughing into the excavation during construction. The presence of subsurface water within the excavations may reduce the stability of excavated slopes. All excavations should be completed, and shored if necessary, in accordance applicable OSHA requirements.

5.3 Groundwater Conditions

Ground water is anticipated to be encountered during conventional bore production. Although shallow groundwater was not encountered during test drilling, existing wetlands are located adjacent to proposed bore/receiving pits. If groundwater is encountered during site excavations, it can likely be controlled using standard drainage measures such as diversion ditches, pumps, and/or subsurface drains.

6.0 STANDARD OF CARE AND REPORT LIMITATIONS

This letter report was prepared for the purpose of design development. Reliance on this letter report by any party other than Transco, its authorized agents, or PADEP is expressly forbidden. Contractors should not rely on conclusions, recommendations, or engineering opinions presented in this letter report for purpose of bid development.

The services performed by CEC were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the geotechnical engineering profession practicing contemporaneously under similar conditions in the locality of the project. No warranty, express or implied, is made. Attachment A contains a document entitled "Important Information About This Geotechnical-Engineering Report." This document further explains the realities of geotechnical engineering and the limitations that exist in evaluating geotechnical issues. Furthermore, the information obtained from the test borings is localized. Subsurface conditions could differ at other locations.

7.0 CLOSING REMARKS

CEC appreciates the opportunity to be of service to you on this project. Please contact us if you have any questions or comments.

Sincerely,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Andrew L. Dietz, E.I.T.
Assistant Project Manager

Michael L. Schumaker, P.E. (PA)
Principal

Enclosures:

- Attachment A – Important Information about This Geotechnical Engineering Report
- Attachment B – Test Boring Location Plan and Profiles
- Attachment C – Test Boring Logs
- Attachment D – Geotechnical Laboratory Testing Results

ATTACHMENT A

IMPORTANT INFORMATION ABOUT THIS GEOTECHNICAL ENGINEERING REPORT

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:
- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:
- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

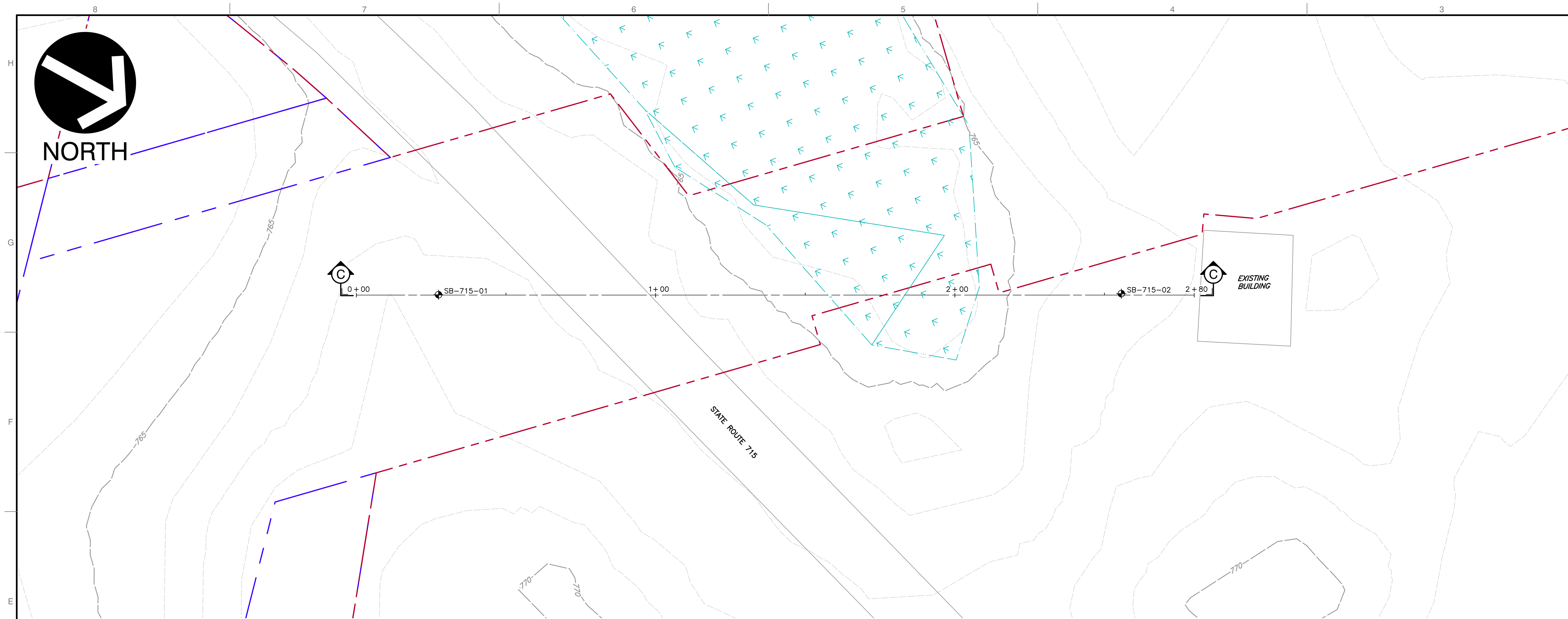
While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

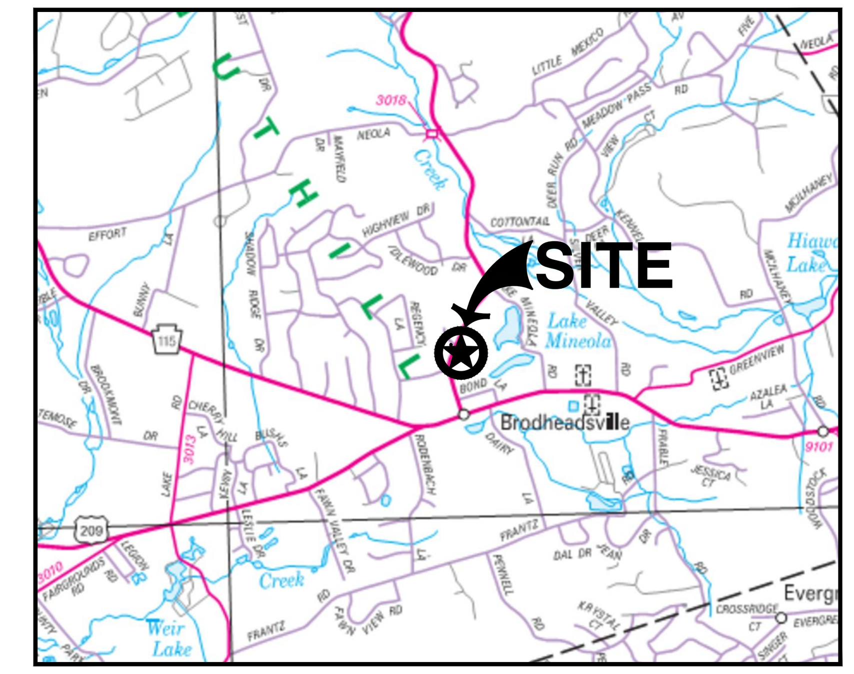
ATTACHMENT B

TEST BORING LOCATION PLAN AND PROFILES



PLAN VIEW

SCALE IN FEET 0 20 40



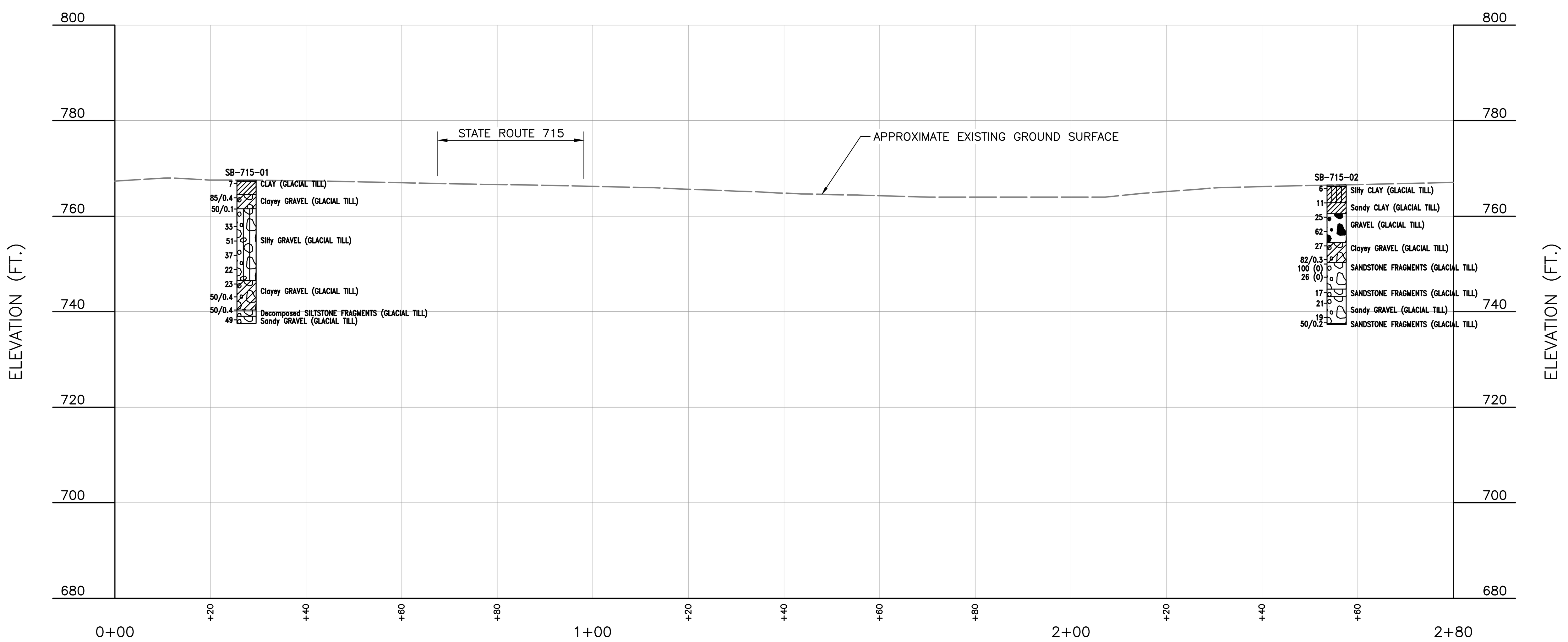
REFERENCE
1. SITE LOCATION MAP, PENNDOT TYPE 10 COUNTY MAP, DATED MARCH 2021.

SITE LOCATION

SCALE IN FEET 0 4000 8000

LEGEND

- 1400 — EXISTING INDEX CONTOUR
- EXISTING INTERMEDIATE CONTOUR
- G — EXISTING GAS LINE
- 485+00 — REAE PIPELINE ALIGNMENT ℄
- EXISTING WETLANDS
- TEMPORARY WORKSPACE
- RIGHT-OF-WAY LINE
- EXISTING PAVED ROADS
- SB-01-01 — TEST BORING LOCATION
- A A — GEOTECHNICAL CROSS SECTION LOCATION



CROSSING PROFILE C-C

SCALE H:1"=20'; V:1"=20'

SCALE IN FEET (HORIZONTAL) 0 20 40

SCALE IN FEET (VERTICAL) 0 20 40

LEGEND

- TEST BORING (PROFILE)
- SB-01-01 MATERIAL TYPE (SEE DEFINITIONS OF STANDARD TERMS AND SYMBOLS)
- N-VALUE, BLOWS/FOOT — 51
- RECOVERY, % — 90
- RQD, % — (0)
- MATERIAL DESCRIPTION
- MEASURED WATER LEVEL AT THE END OF ROCK CORING
- MEASURED WATER AT END OF SOIL SAMPLING

GEOLOGIC CONDITIONS

1. THE TEST BORING INFORMATION PRESENTED HEREIN DEPICTS SUBSURFACE CONDITIONS AT THE TEST BORING LOCATIONS AND AT THE TIME OF DRILLING. SOIL CONDITIONS AT OTHER LOCATIONS MAY DIFFER.
2. GEOLOGIC CORRELATIONS BETWEEN TEST BORINGS ARE GENERALLY BASED ON STRAIGHT-LINE INTERPOLATION. ACTUAL CONDITIONS BETWEEN TEST BORINGS MAY DIFFER.

REFERENCES

1. EXISTING CONTOURS DERIVED FROM A BARE-EARTH DIGITAL ELEVATION MODEL CONSTRUCTED FROM PAMAP LIDAR (LIGHT DETECTION AND RANGING) ELEVATION POINTS. TOPOGRAPHIC CONTOURS MAPPED AT AN INTERVAL OF 2 FEET; DEVELOPED BY PAMAP PROGRAM, PA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES, BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY; DATED 2006.
2. AERIAL PHOTOGRAPHY PROVIDED BY GOOGLE EARTH, ACCESS THOUGH PLEX EARTH, DATE OF PHOTOGRAPHY (MARCH 25, 2021).
3. EXISTING AND PROPOSED SITE FEATURES BY WILLIAMS FIELD SERVICES COMPANY, LLC.
4. ENVIRONMENTAL FEATURES, PIPELINE ALIGNMENT, AND RELATED CONTENT PROVIDED BY WILLIAMS MIDSTREAM, LLC VIA EMAIL BETWEEN 02/10/2022 AND 02/14/2022.

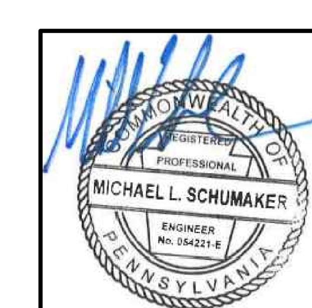
P:\300-000\303-105\-CADD\Dwg\GT02\303105-GT01-C309.dwg{GT01} LS:(2/22/2022 - tpirkle) - LP: 2/22/2022 7:49 AM

REVISION RECORD

NO	DATE	DESCRIPTION

Civil & Environmental Consultants, Inc.
333 Baldwin Road · Pittsburgh, PA 15205
412-429-2324 · 800-365-2324
www.cecinc.com

WILLIAMS FIELD SERVICES COMPANY, LLC
TRANSCONTINENTAL GAS PIPELINE CO., LLC
REA - CONVENTIONAL BORE
CHESTNUTHILL TOWNSHIP
MONROE COUNTY, PENNSYLVANIA



SR 715 - WETLAND CROSSING
CONVENTIONAL BORE PLAN AND PROFILE

DATE:	OCTOBER 2021	DRAWN BY:	TAP
DWG SCALE:	AS SHOWN	CHECKED BY:	ALD
PROJECT NO:	303-105.1000		
APPROVED BY:	MLS		

DRAWING NO.: GT01

ATTACHMENT C

TEST BORING LOGS

Rock Types

Rock Name	Characteristics	Symbol
Shale	Clay sized particles, shale has fissility which is a horizontal sheet-like or laminated feature.	
Claystone	Clay sized particles that are consolidated, lacking fissility.	
Siltstone	Composed of silt, normally breaks as irregular chunks	
Sandstone	Primarily sand sized particles modified w/ the descriptor fine, medium, or coarse.	
Conglomerate	Gravel sized grains and larger held together by finer material, called a breccia if clasts are angular.	
Limestone	Effervesses w/ diluted HCl, can be composed of clay up to gravel particles (fossils).	
Coal	Black and shiny, can break into cubes or conchoidally.	

Rock Quality Descriptions

Weathering

Completely Weathered: All rock material is decomposed and/or disintegrated. The original rock structure may still be intact.

Highly Weathered: More than half of the rock material is decomposed. Fresh rock is present only as a discontinuous framework or as corestones.

Moderately Weathered: Less than half of the rock material is decomposed. Fresh rock is present at a discontinuous framework or as corestones.

Slightly Weathered: Discoloration or staining indicates weathering of rock material on discontinuity surfaces. Rock may be discolored and softened.

Fresh: No visible signs of rock material weathering.

RQD

Descriptor	%
Very Poor	<25
Poor	25-50
Fair	50-75
Good	75-90
Excellent	>90

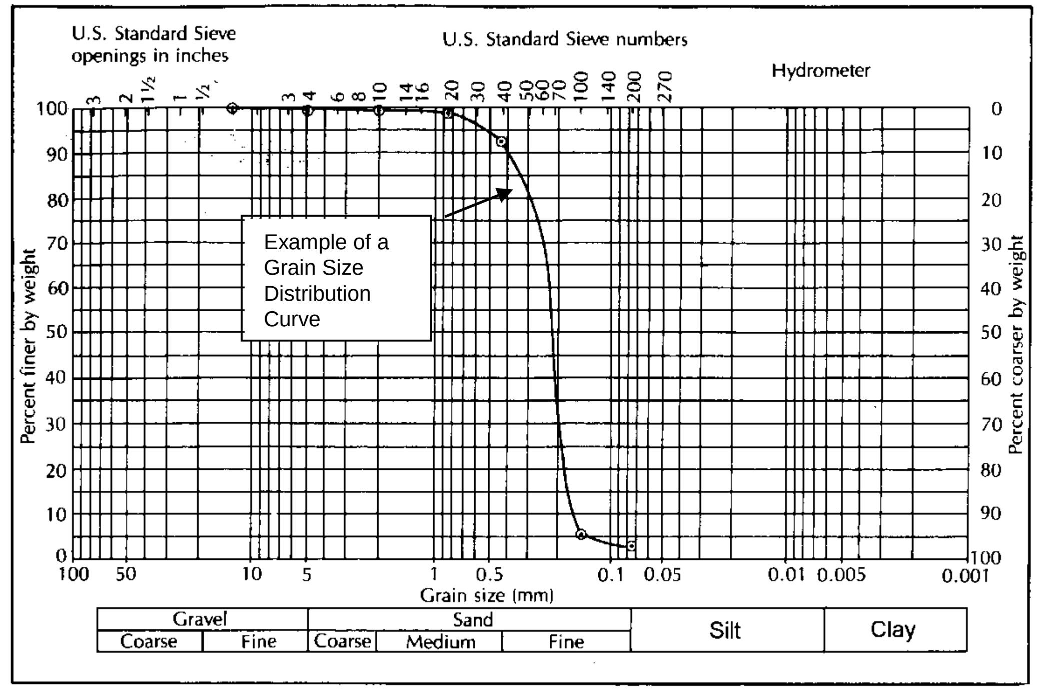
Brokenness

Descriptor	Fracture Spacing (in & ft)
Very Broken	< 1 (<0.08)
Broken	1-3 (0.08-0.25)
Moderately Broken	3-6 (0.25-0.5)
Slightly Broken	>6 (>0.5)

Rock Hardness

Descriptor	Field Criterion	Relative Unconfined Compressive Strength
Very Hard	Difficult to break w/ Hammer	> 30,000 psi
Hard	Hand-held sample breaks w/ Hammer	8,000 to 30,000 psi
Medium Hard	Cannot scrape surface w/ knife	2,000 to 8,000 psi
Soft	Cutting or scraping w/ knife difficult	500 to 2,000 psi
Very Soft	Can be cut w/ knife	< 500 psi

Grain Size Distribution Curve



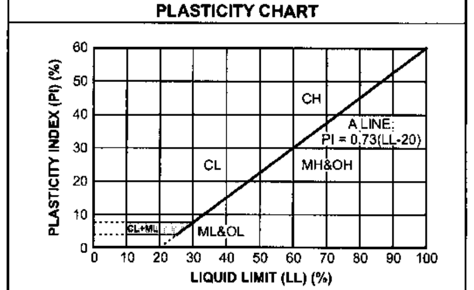
UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART		
COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)		
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	
	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	
	GM	Silty gravels, gravel-sand-silt mixtures
	GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	
	SW	Well-graded sands, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	
	SM	Silty sends, sand-silt mixtures
	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of materiel is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	ML	Inorganic silts and very fine sands, rock flour, silty of 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 50% or greater	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

LABORATORY CLASSIFICATION CRITERIA		
GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), 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

PLASTICITY CHART



Glossary

Alluvial Soil: Soil deposited by water in a river, stream, floodplain, or delta.

Bedrock: General term describing solid rock underlying soil or other unconsolidated surficial materials.

Colluvial Soil: Incoherent soil on or at the base of a slope deposited by gravity or slope movement.

Fill: Soil derived from natural soil, rock, or processed materials that was placed by artificial methods, such as construction, waste disposal, or dumping.

Glacial Outwash: Soil, typically sand and gravel, deposited by glacial streams or meltwater in a preexisting valley or over a plain.

Glacial Till: Soil deposited by and underneath a glacier, generally consisting of a heterogeneous, unstratified mixture of clay, sand, gravel, and boulders.

N-Value: The blow count representation of the penetration resistance of the soil determined by the Standard Penetration Test (SPT). It is the sum of the number of blows required to drive the sampler the second and third 6-inch increments (sample depth interval of 6 to 18 inches) and is recorded in blows per foot (bpf). The N-value is considered to be an indication of the relative density of coarse-grained soils (sand and gravel) or consistency of fine-grained soils (silt and clay).

Pocket Pen: Field penetration test performed using a hand-held penetrometer that estimates unconfined compressive strength of cohesive soil in tons per square foot (tsf).

Recovery %: Total length of rock core or soil sample retrieved divided by the total length of the core run or sample interval, expressed as a percentage.

Residual Soil: Soil derived from the physical or chemical weathering of the underlying parent bedrock, but is soft enough to be penetrated by a split-spoon sampler.

Refusal: The depth at which 50 SPT hammer blows or more are required to drive the sampling spoon 6 inches or less. Samples that encounter refusal are assigned an N-value of 100 bpf.

Rock Quality Designation (RQD): The sum of the length of intact rock core pieces longer than 4 inches (excluding mechanical breaks) divided by the total length of the core run, expressed as a percentage.

Shelby Tube: A 2" to 3" thin walled sampling tube that is pushed into the soil to obtain a relatively undisturbed soil sample for geotechnical laboratory tests.

Split Spoon Sampler: A soil sampling tube which is driven, retrieved, and split-open lengthwise for removal and visual inspection, and testing of the soil obtained.

Standard Penetration Test (SPT) ASTM D1586 : Field penetration test consisting of driving a 2-inch outside diameter split-spoon sampler 18 inches using a 140-pound hammer free falling a distance of 30 inches. The number of blows required to advance the spoon through successive 6-inch increments is recorded to determine the N-value.

N-Value Rating

Fine-Grained Soils

Consistency	Blows/ft
Very Soft	0-2
Soft	3-4
Medium Stiff	5-8
Stiff	9-15
Very Stiff	16-30
Hard	>30

Coarse-Grained Soils

Relative Density	Blows/ft
Very Loose	0-4
Loose	5-10
Medium Dense	11-30
Dense	31-50
Very Dense	>50

Unconsolidated Material

Term	Grain Size (mm)	Example Size
Clay	<1/250	can't see grains
Silt	1/250 - 1/16	grains seen w/ naked eye
Fine Sand	1/16 - 1/4	table salt to sugar
Med. Sand	1/4 - 2.0	openings in a window screen
Course Sand	2.0 - 4.75	sidewalk salt
Gravel	4.75 - 75	pea to tennis ball
Cobble	75 - 300	orange to tennis ball
Boulder	>300	larger than a basketball

Modifiers for Soils with Two Grain Sizes

Term	%	Term	%
Trace	< 12	Some	12-30
Adjective (i.e. silty)	30-45	And	45-55

Moisture Content

Dry: Sample is dusty or very obviously very dry.
Moist: Anything that does not fit the definition of dry or wet.
Wet: Sample contains free water.

Civil & Environmental Consultants, Inc.

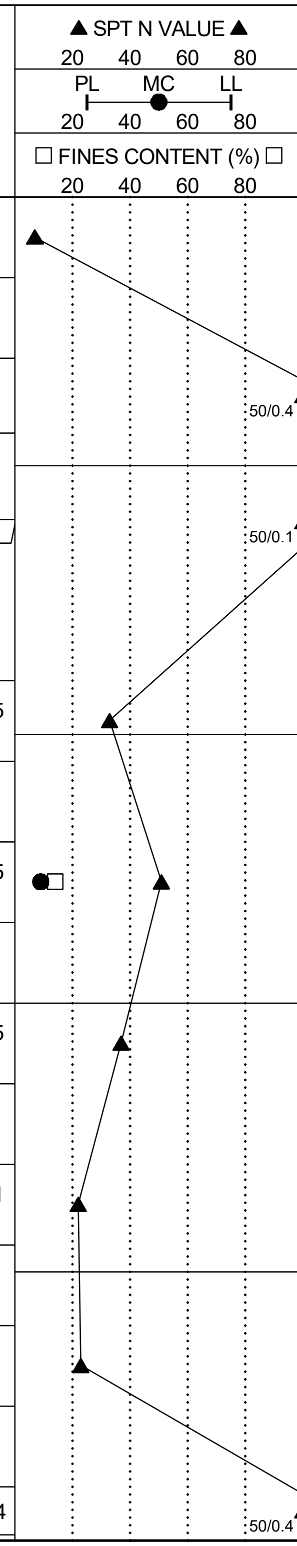
Definitions of Standard Terms and Symbols

BORING NUMBER SB-715-01

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

CLIENT Williams Midstream Services, LLC
PROJECT NAME Regional Energy Access Expansion Pipeline
PROJECT NUMBER 310-327
PROJECT LOCATION Monroe County, PA
DATE STARTED 4/13/21 **COMPLETED** 4/13/21
GROUND ELEVATION 767 ft **BACKFILL** Grout and Auger Cuttings
SOIL SAMPLING CONTRACTOR Test Boring Services, Inc.
WATER LEVELS:
SOIL SAMPLING METHOD Hollow Stem Auger
AT END OF SOIL SAMPLING --- Dry
CEC REP PJM **CHECKED BY** NAZ
AT END OF CORING --- Not Applicable
NOTES State Road 715 / Wetland Crossing
AFTER DRILLING --- Backfilled Immediately

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)
	Topsoil-0.3 feet bgs	0			
	Brown and black CLAY, some gravel, some carbonaceous shale fragments, moist, medium stiff, **(GLACIAL TILL)**		SS 1	67	2-3-4 (7)
765					
	Brown and gray clayey GRAVEL, some sand, moist, very dense, **(GLACIAL TILL)**		SS 2	100	33-35-50/0.4
		5			
	Brown silty GRAVEL, some sand, moist, medium dense to very dense, **(GLACIAL TILL)** *Drill action indicates the presence of probable cobbles/boulders throughout the strata. Difficulty advancing augers.*		SS 3	100	50/0.1
760					
		10	SS 4	20	28-18-15 (33)
755					
			SS 5	100	24-26-25 (51)
		15			
			SS 6	100	48-22-15 (37)
750					
			SS 7	100	12-11-11 (22)
		20			
	Brown and gray clayey GRAVEL, some sand, moist, medium dense to very dense, **(GLACIAL TILL)**		SS 8	100	7-11-12 (23)
745					
		25	SS 9	100	38-50/0.4



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Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-715-01

CLIENT Williams Midstream Services, LLC
PROJECT NAME Regional Energy Access Expansion Pipeline
PROJECT NUMBER 310-327
PROJECT LOCATION Monroe County, PA

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
			25				
740		Brown and gray clayey GRAVEL, some sand, moist, medium dense to very dense, **(GLACIAL TILL)** *(continued)*					
		Gray decomposed SILTSTONE FRAGMENTS, dry, very dense, **(GLACIAL TILL)** *Difficulty augering*		SS 10	100	50/0.4	50/0.4
		Gray and brown sandy GRAVEL, some clay, moist, dense, **(GLACIAL TILL)**	30	SS 11	100	24-28-21 (49)	

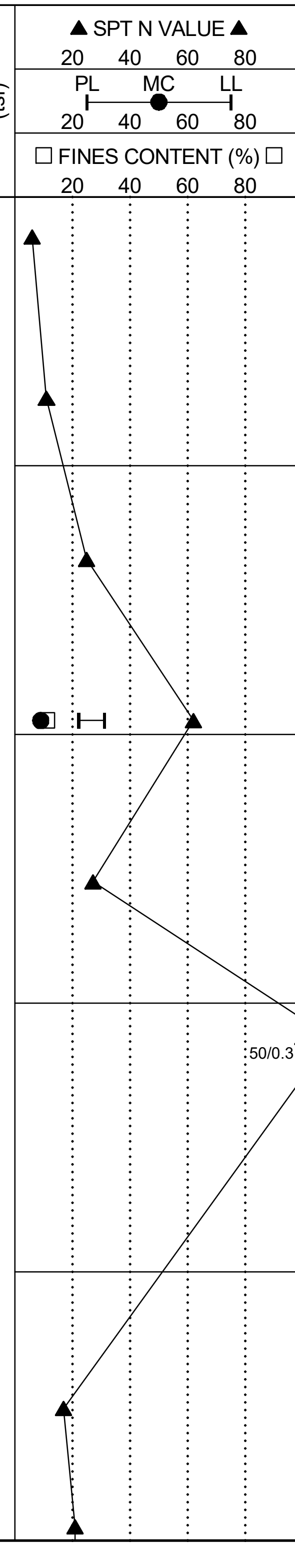
Bottom of boring at 30.0 feet.

Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-715-02

CLIENT Williams Midstream Services, LLC
PROJECT NAME Regional Energy Access Expansion Pipeline
PROJECT NUMBER 310-327
PROJECT LOCATION Monroe County, PA
DATE STARTED 4/8/21 **COMPLETED** 4/8/21
GROUND ELEVATION 766 ft **BACKFILL** Grout and Auger Cuttings
SOIL SAMPLING CONTRACTOR Test Boring Services, Inc.
WATER LEVELS:
SOIL SAMPLING METHOD Hollow Stem Auger
AT END OF SOIL SAMPLING --- Dry
CEC REP PJM **CHECKED BY** NAZ
AT END OF CORING --- Not Applicable
NOTES State Road 715 / Wetland Crossing
24hrs AFTER DRILLING --- Backfilled Immediately

ELEVATION (ft)	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)
766	Topsoil-0.3 feet bgs	0				
765	Brown silty CLAY, some rock fragments, moist, medium stiff, **(GLACIAL TILL)**		SS 1	53	2-3-3 (6)	1.0
	Brown sandy CLAY, some sandstone fragments, wet, stiff, **(GLACIAL TILL)**		SS 2	100	3-5-6 (11)	1.0
760	Brown GRAVEL, some sand, trace clay, moist, medium dense to very dense, **(GLACIAL TILL)**	5	SS 3	100	16-14-11 (25)	
	Bulk Sample obtained from 0-9' bgs	10	SS 4	100	34-28-34 (62)	
755	Brown clayey GRAVEL, some sand, moist, medium dense to very dense, **(GLACIAL TILL)**		SS 5	100	19-15-12 (27)	
750		15	SS 6	100	26-32-50/0.3	
	Auger refusal encountered at 16.3' bgs, Rock coring was used to advance through the boulders. Dark gray SANDSTONE FRAGMENTS, wet, very dense, **(GLACIAL TILL)**		NQ 1	100 (0)		
745		20	NQ 2	26 (0)		
	Dark gray SANDSTONE FRAGMENTS, wet, medium dense, **(GLACIAL TILL)**		SS 7	7	6-7-10 (17)	
	Brown sandy GRAVEL, some clay, wet, medium dense, **(GLACIAL TILL)**	25	SS	20	11-10-11	



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Civil & Environmental Consultants, Inc.
333 Baldwin Road
Pittsburgh, PA 15205

BORING NUMBER SB-715-02

CLIENT Williams Midstream Services, LLC

PROJECT NAME Regional Energy Access Expansion Pipeline

PROJECT NUMBER 310-327

PROJECT LOCATION Monroe County, PA

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	▲ SPT N VALUE ▲ 20 40 60 80 / PL MC LL 20 40 60 80 / ☐ FINES CONTENT (%) ☐ 20 40 60 80
			25					
740		Brown sandy GRAVEL, some clay, wet, medium dense, **(GLACIAL TILL)** *(continued)*		8		(21)		
				SS 9	13	7-7-12 (19)		
		Brown and dark gray SANDSTONE FRAGMENTS, wet, very dense, **(GLACIAL TILL)**		SS 10	100	14-50/0.2		50/0.2

Bottom of boring at 29.2 feet.

ATTACHMENT D

GEOTECHNICAL LABORATORY TESTING RESULTS

PARTICLE-SIZE ANALYSIS OF SOILS - ASTM D422-63(2007)

Client	Civil & Environmental Consultants, Inc	Boring	SB-715-01
Client Project	310-327 REAE Lateral Pipeline	Depth	9.0' - 16.5'
Project No.	44117	Sample	SS-4,5
		Lab Sample	44117002

Sample Color: **BROWN**
USCS Group Name: **SILTY GRAVEL WITH SAND**
USCS Group Symbol: **GM** USDA: **NA** AASHTO: **A-1-b (0)**

MECHANICAL SIEVE

Total Sample	
Total Sample Wet Wt, gm (-3")	325
Sample Split on Sieve	No. 4
Coarse Washed Dry Sample, gm	190
Wet Wt Passing Split, gm	135
Dry Wt. Passing Split, gm	124
Total Sample Dry Wt, gm	314
Split Sample - Passing No. 4	
Tare No.	2009
Tare + WS., gm	210.84
Tare + DS., gm	205.93
Tare, gm	150.45
Water Content of Split Sample	**8.9%**
Wt. of DS., gm	55.48
Wt. of +#200 Sample, gm	35.36

Sieve Size	Nominal Opening, mm	Dry Wt, gm	Split Normalized % Retained	Split Normalized % Finer	Project Specifications
3"	75	0.00	0.0%	100.0%	
2-1/2"	63	0.00	0.0%	100.0%	
2"	50	0.00	0.0%	100.0%	
1-1/2"	37.5	0.00	0.0%	100.0%	
1"	25	91.46	29.1%	70.9%	
3/4"	19	24.00	7.6%	63.2%	
1/2"	12.5	31.50	10.0%	53.2%	
3/8"	9.5	14.00	4.5%	48.7%	
No. 4	4.75	28.81	9.2%	39.6%	
No. 10	2	9.23	6.6%	33.0%	
No. 20	0.85	7.12	5.1%	27.9%	
No. 40	0.425	4.55	3.2%	24.7%	
No. 60	0.25	3.58	2.6%	22.1%	
No. 140	0.106	8.23	5.9%	16.2%	
No. 200	0.075	2.65	1.9%	14.3%	

USCS SOIL CLASSIFICATION

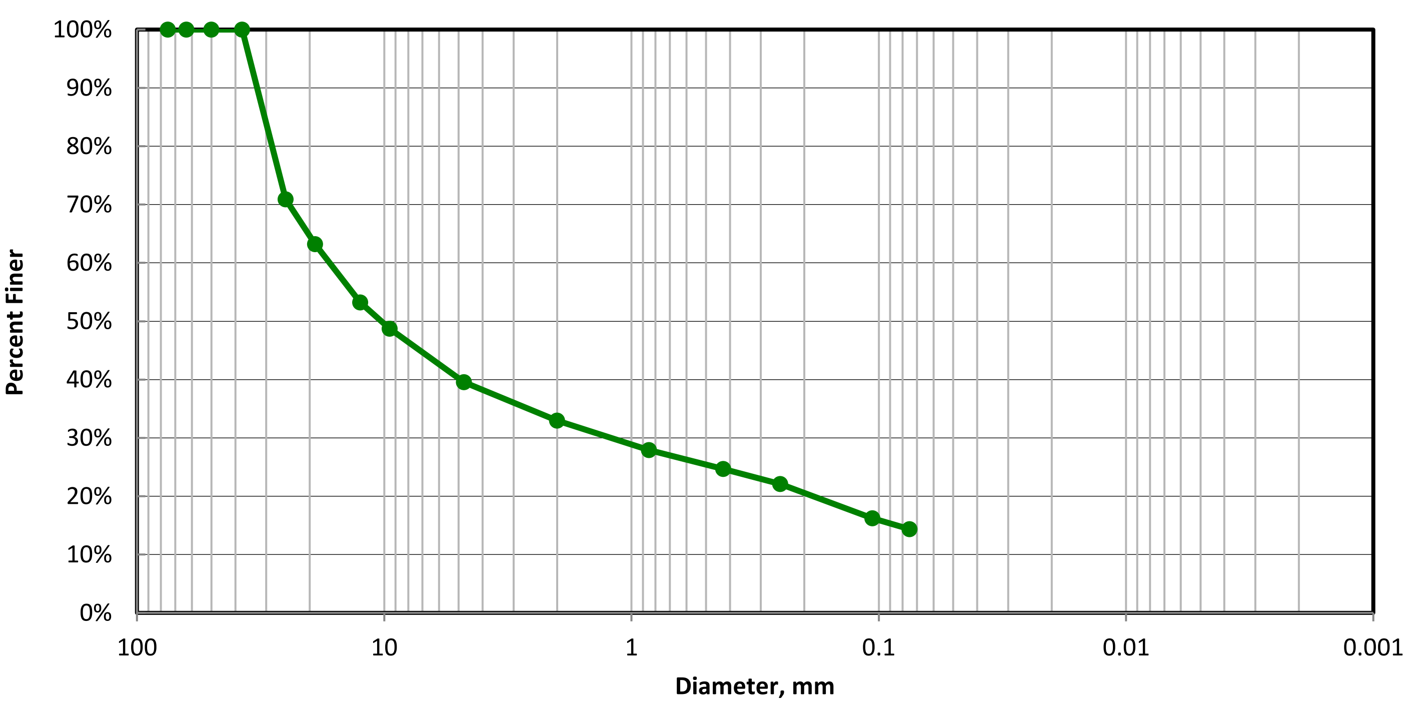
Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**60.4**	Silt=NA Clay=NA	
Coarse=36.8; Fine=23.7		D60, mm	NA
% Sand (-#4 & +#200)	**25.2**	D30, mm	NA
Coarse=6.6; Medium=8.3; Fine=10.3		D10, mm	NA
% Fines (-#200)	**14.3**	Cc	NA
% Plus #200 (-3")	**85.7**	Cu	NA

USCS Description: **SILTY GRAVEL WITH SAND**

USCS Group Symbol	Atterberg Limits Group Symbol
GM	**NP - NON PLASTIC**

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0



Performed By: VA Input Validation: BLS Reviewed By: ALO Date Tested: 4/23/2021

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D4318-17e1

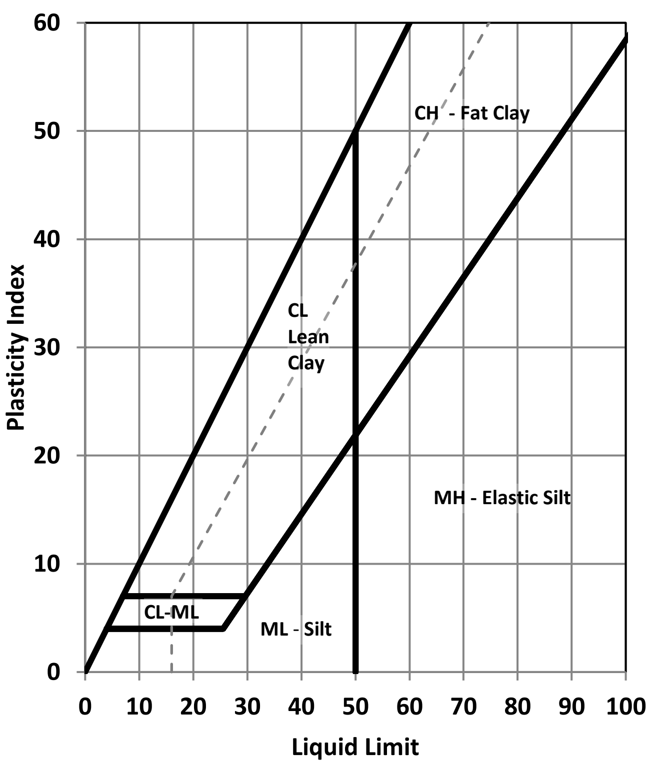
Client	Civil & Environmental Consultants, Inc	Boring	SB-715-01
Client Project	310-327 REAE Lateral Pipeline	Depth	9.0' - 16.5'
Project No.	44117	Sample	SS-4,5
		Lab Sample	44117002

Soil Description: BROWN NON PLASTIC MATERIAL
(-#40 Fraction)

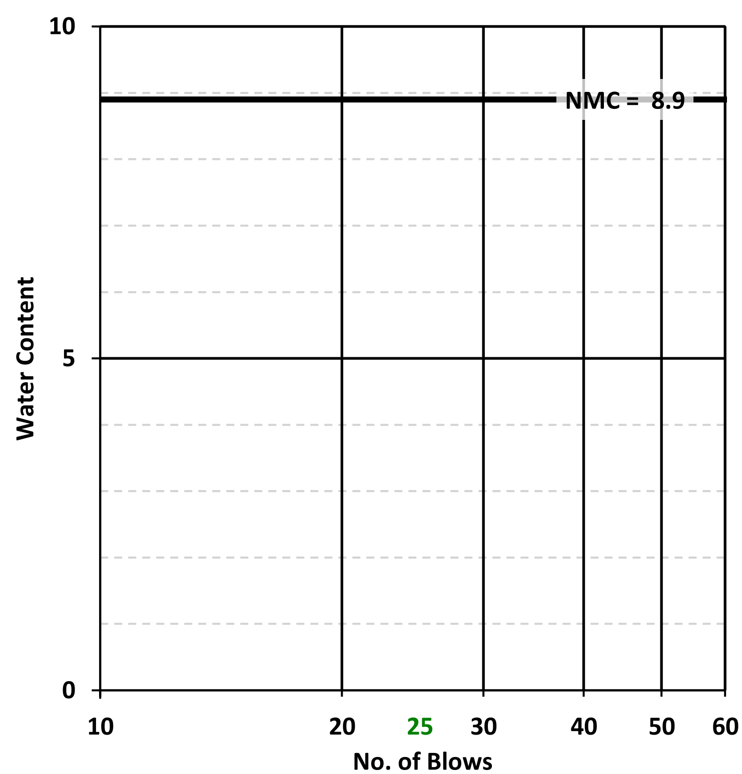
AS-RECEIVED W.C.		SAMPLE SUMMARY	
Tare Number	2009	Liquid Limit (LL), %	NA
Wt. Tare & WS, gm	210.84	Plastic Limit (PL), %	NA
Wt. Tare & DS, gm	205.93	Plasticity Index (PI)	NA
Wt. Tare, gm	150.45	USCS Group Symbol (*-#40 Fraction*)	NP
Water Content, %	8.9	USCS Group Name (*-#40 Fraction*)	NON PLASTIC
		Sample Color:	BROWN

PLASTIC LIMIT		LIQUID LIMIT
Points Run	0 Non-Plastic	0 Non-Plastic
Tare Number		
Wt. Tare & WS, gm		
Wt. Tare & DS, gm		
Wt. Tare, gm		
Water Content, %		
		# of Blows

PLASTICITY CHART



FLOW CURVE



Performed By: ZH   Input Validation: BLS   Reviewed By: ALO   Date Tested: 4/23/2021

PARTICLE-SIZE ANALYSIS OF SOILS - ASTM D422-63(2007)

Client	Civil & Environmental Consultants, Inc	Boring	SB-715-02
Client Project	310-327 REAE Lateral Pipeline	Depth	6.0' - 13.5'
Project No.	44117	Sample	SS-3,4,5
		Lab Sample	44117003

Sample Color: **BROWN**
USCS Group Name: **WELL-GRADED GRAVEL WITH CLAY AND SAND**
USCS Group Symbol: **GW-GC** USDA: **NA** AASHTO: **A-2-4 (0)**

MECHANICAL SIEVE

Total Sample	
Total Sample Wet Wt, gm (-3")	658
Sample Split on Sieve	No. 4
Coarse Washed Dry Sample, gm	353
Wet Wt Passing Split, gm	305
Dry Wt. Passing Split, gm	279
Total Sample Dry Wt, gm	632
Split Sample - Passing No. 4	
Tare No.	2005
Tare + WS., gm	241.97
Tare + DS., gm	234.2
Tare, gm	151.38
Water Content of Split Sample	**9.4%**
Wt. of DS., gm	82.82
Wt. of +#200 Sample, gm	62.88

Sieve Size	Nominal Opening, mm	Dry Wt, gm	Split Normalized % Retained	Split Normalized % Finer	Project Specifications
3"	75	0.00	0.0%	100.0%	
2-1/2"	63	0.00	0.0%	100.0%	
2"	50	0.00	0.0%	100.0%	
1-1/2"	37.5	0.00	0.0%	100.0%	
1"	25	117.23	18.5%	81.5%	
3/4"	19	80.45	12.7%	68.7%	
1/2"	12.5	60.07	9.5%	59.2%	
3/8"	9.5	35.33	5.6%	53.6%	
No. 4	4.75	60.05	9.5%	44.1%	
No. 10	2	20.84	11.1%	33.0%	
No. 20	0.85	17.93	9.6%	23.5%	
No. 40	0.425	8.93	4.8%	18.7%	
No. 60	0.25	5.44	2.9%	15.8%	
No. 140	0.106	7.66	4.1%	11.7%	
No. 200	0.075	2.08	1.1%	10.6%	

USCS SOIL CLASSIFICATION

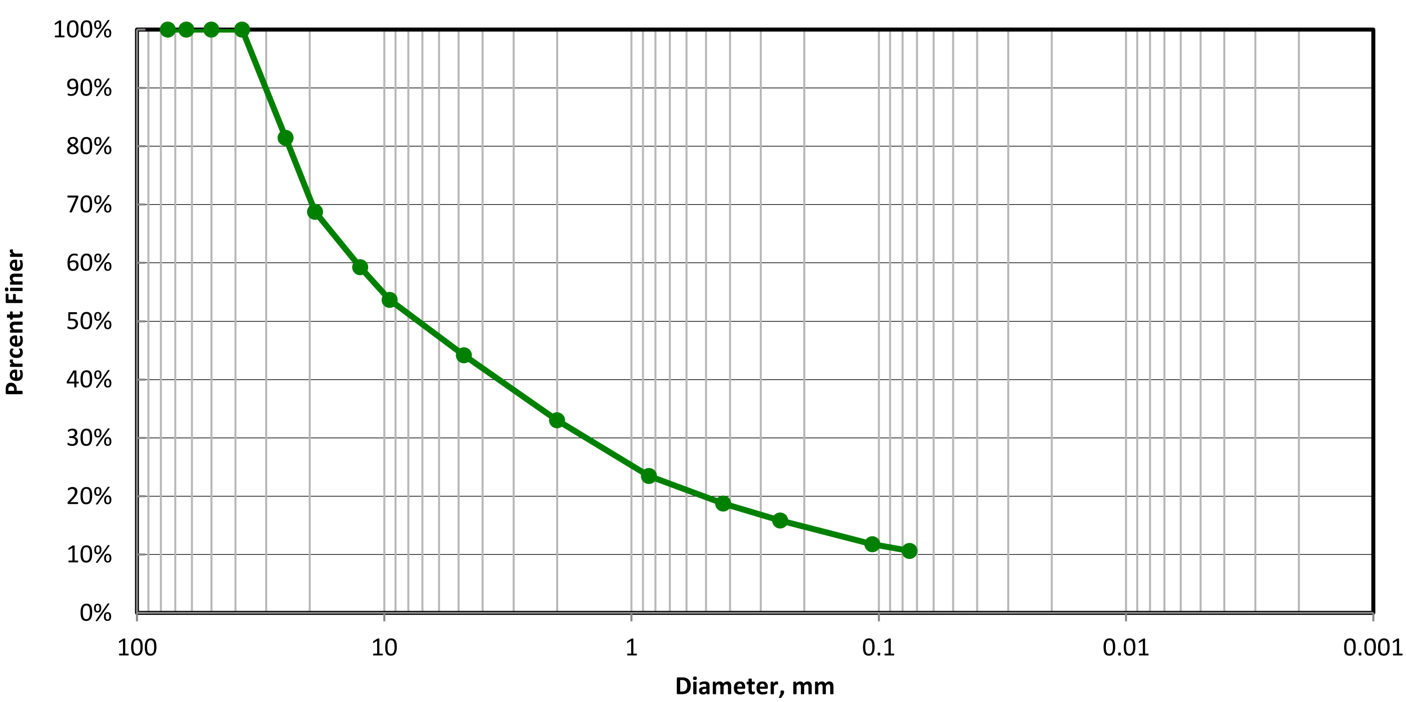
Corrected For 100% Passing a 3" Sieve

% Gravel (-3" & +#4)	**55.9**	Silt=NA Clay=NA	
Coarse=31.3; Fine=24.6		D60, mm	12.93
% Sand (-#4 & +#200)	**33.5**	D30, mm	1.52
Coarse=11.1; Medium=14.3; Fine=8.1		D10, mm	0.06
% Fines (-#200)	**10.6**	Cc	2.91
% Plus #200 (-3")	**89.4**	Cu	209.78

USCS Description
WELL-GRADED GRAVEL WITH CLAY AND SAND

USCS Group Symbol	Atterberg Limits Group Symbol
GW-GC	CL - LEAN CLAY

Auxiliary Information	Wt Ret, gm	% Retained	% Finer
12" Sieve - 300 mm	0	0.0	100.0
6" Sieve - 150 mm	0	0.0	100.0
3" Sieve - 75 mm	0	0.0	100.0



Performed By: VA Input Validation: BLS Reviewed By: ALO Date Tested: 4/23/2021

LIQUID LIMIT, PLASTIC LIMIT, AND PLASTICITY INDEX OF SOILS
ASTM D4318-17e1

Client	Civil & Environmental Consultants, Inc	Boring	SB-715-02
Client Project	310-327 REAE Lateral Pipeline	Depth	6.0' - 13.5'
Project No.	44117	Sample	SS-3,4,5
		Lab Sample	44117003

Soil Description: BROWN LEAN CLAY
(-#40 Fraction)

AS-RECEIVED W.C.

Tare Number	2005
Wt. Tare & WS, gm	241.97
Wt. Tare & DS, gm	234.20
Wt. Tare, gm	151.38
Water Content, %	9.4

SAMPLE SUMMARY

Liquid Limit (LL), %	**31**
Plastic Limit (PL), %	**22**
Plasticity Index (PI)	**9**
USCS Group Symbol (*-#40 Fraction*)	**CL**
USCS Group Name (*-#40 Fraction*)	**LEAN CLAY**
Sample Color:	**BROWN**

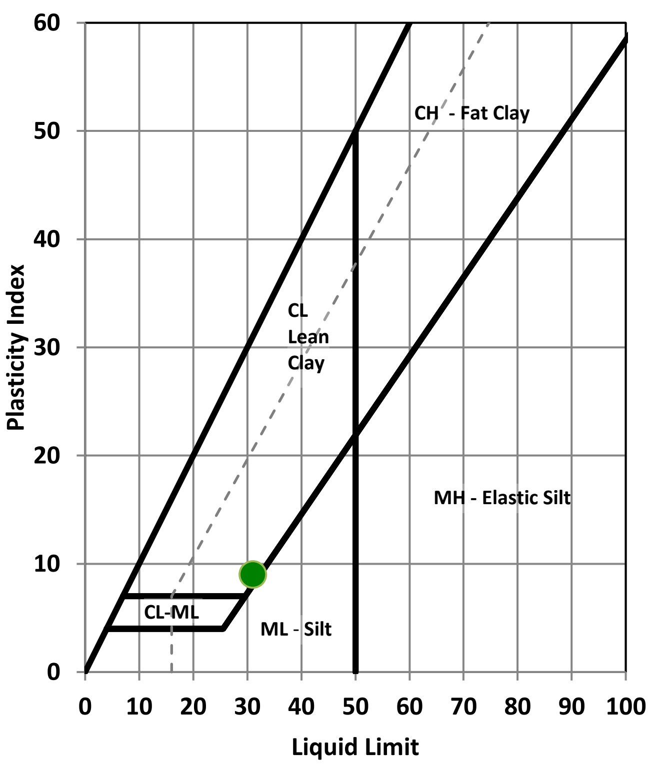
PLASTIC LIMIT

Points Run	3 Points		
Tare Number	456	493	433
Wt. Tare & WS, gm	18.20	17.73	18.02
Wt. Tare & DS, gm	16.89	16.50	16.71
Wt. Tare, gm	10.89	10.72	10.71
Water Content, %	21.8	21.3	21.8

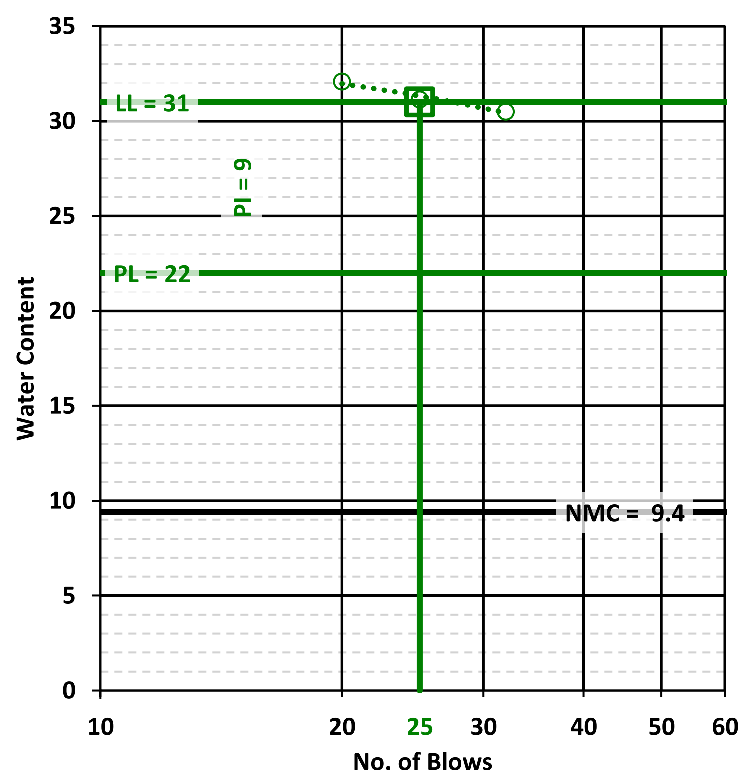
LIQUID LIMIT

	3 Points		
	239	249	263
	24.48	23.61	24.23
	22.52	21.91	22.36
	16.41	16.45	16.23
	32.1	31.1	30.5
# of Blows	20	25	32

PLASTICITY CHART



FLOW CURVE



Performed By: ZH   Input Validation: BLS   Reviewed By: ALO   Date Tested: 4/23/2021