Transcontinental Gas Pipe Line Company, LLC

Attachment B – Geological Hazard Assessment and Mitigation Plan

Regional Energy Access Expansion Project

April 2021

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Attachment B

ATTACHMENT B-1
PIPELINE GEOHAZARD ASSESSMENT

August 31, 2020
(Revised November 23, 2020)

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

Dear Mr. Becker:

Subject: Geotechnical Engineering Letter Report
Geohazard Assessment for Regional Energy Access Pipeline Project
Luzerne and Monroe Counties, Pennsylvania
CEC Project 303-105

Civil & Environmental Consultants, Inc. (CEC) presents to Transcontinental Gas Pipe Line Company, LLC (Transco) this revised report presenting our findings and recommendations associated with the subject project. The report was revised to reflect updates in the proposed pipeline alignment and coal seam nomenclature. CEC developed this revised report to summarize our literature review and field reconnaissance and to present generalized opinions and recommendations for implementing best management practices to address potential geohazards during pipeline construction. The report and figures were revised to reflect updates to the project layout. Attachments to this report include Attachment A – "Important Information about Your Geotechnical Engineering Report" Attachment B – "Geohazard Figures" and Attachment C "Geohazard Mitigation Details."

The following sections of this report include a discussion, data obtained and significance determination, conclusions and recommendations, standard of care and report limitations, and closing remarks.

1.0 DISCUSSION

Transco is proposing to install two (2) buried natural gas pipelines in Monroe and Luzerne Counties, Pennsylvania as part of the Regional Energy Access project. The two pipelines include the proposed 42 inch Effort Loop pipeline in Monroe County and the proposed 30 inch Regional Energy Lateral (REL) pipeline in Luzerne County. Transco provided CEC with the results of a preliminary desktop geohazard summary detailing landslide hazards, site soils and bedrock, mining and coal deposits, seismic hazards, karst maps, and topographic maps flagging slopes steeper than 2.5H: 1V (Horizontal: Vertical) along the two proposed pipelines. This information was considered during the development of this report.

2.0 DATA OBTAINED AND SIGNIFICANCE DETERMINATION

CEC reviewed the "Regional Energy Access Project Preliminary Desktop Geohazard Review Summary" prepared by Transco dated May 1, 2020. CEC also conducted an independent desktop literature review to identify and evaluate potentially hazardous naturally occurring geologic formations and soil conditions (geohazards) along the pipeline alignments. CEC reviewed publically available documents as outlined in Section 2.1 relative to soil types and geology, landslides, slope gradients, karst geology/sinkholes, radioactive or arsenic bearing formations, mining, and coal outcrops. CEC's purpose in reviewing these documents was to identify potential areas for further field study and, where appropriate, provide recommendations to reduce the risk of ground movement or environmental impact due to naturally occurring geohazards during and after new pipeline construction. Based on the literature review, CEC identified locations (areas of interest or AOIs) that appeared to be at elevated-risk for ground movement due to naturally occurring geohazards.

2.1 Desktop Literature Review

CEC reviewed the following publically available information to identify potential geohazard AOIs that may be encountered along the project limits:

- United States Department of Agriculture (USDA), On-line Soil Survey Geographic Database for Luzerne and Monroe County, Pennsylvania;
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 59, "Glacial Deposits of Pennsylvania";
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 64, "Surficial Materials of Pennsylvania";
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 13, "Physiographic Provinces of Pennsylvania";
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 7, "Geologic Map of Pennsylvania";
- United States Geological Survey (USGS), Geologic Map of Pennsylvania - Map 1, dated 1980 (online);
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources, "Density of Mapped Karst Features in South-Central and Southeastern Pennsylvania";
- United States Geological Survey, "Landslide Overview Map of the Conterminous United States", dated 1978;
- Department of Internal Affairs Topographic and Geologic Survey, "Map of the Coal Fields of Pennsylvania"
- Pennsylvania Department of Environment Protection (PADEP), Mine Subsidence Insurance Program, Check for Risk Application (Online);
- United States Environmental Protection Agency (USEPA), Map of Radon Zones (Online);
- USGS Open-File Report 2014–1082 "Geochemical and Mineralogical Maps for Soils of the Conterminous United States," dated 2014; and

- Hill, F.A, 1888, "Columnar Sections of the Coal Measures in the Vicinity of Wyoming and Pittston, Luzerne County", Geological Survey of Pennsylvania, Northern Coal Field Columnar Section Sheet No. VI
- Pennsylvania DEP Mine Map "geor_BMSA_6816_001.sid"

Sections 2.2 through 2.8 present pertinent data obtained from the material referenced above for each of the pipeline alignments (i.e. Effort Loop and Regional Energy Lateral).

2.2 Soils

According to the DCNR Map 64, "Surficial Materials of Pennsylvania", the near surface soils within the proposed limits of disturbance of the REL pipeline alignment in Luzerne County consist of a sandy glacial diamict with moderate to abundant silt and sand matrix and minimal clay. The thickness of the diamict is variable, with 25-50% of the area having a thickness of greater than 3 feet. The sandy glacial diamict has minimal weathering, thin soil development, and generally has suffered little erosion. The near surface soils at the segment of the REL pipeline that crosses the Susquehanna River consist of stratified sand and gravel. The stratified sand and gravel includes flat-surfaced deposits in valley bottoms and hummocky deposits along valley sides. The near surface soils within the proposed limits of disturbance of the Effort Loop pipeline in Monroe County consist of sandy to silty glacial diamict with small amounts of clay and is variable in thickness. The diamict has generally moderately weathered, moderately thick soil development, and has been moderately to severely eroded. The near surface soils at the segment of the Effort Loop pipeline near Brodheadsville, Pennsylvania consist of stratified sand and gravel, similar to that of the REL alignment.

The USDA soil survey indicates that the site soils generally consist of residuum, glacial till, glacial outwash, and alluvium. However, portions of the Right-Of-Way (ROW) extend through colluvium, histosols (peaty/organic soils), and mine spoil or other man-made fill. Colluvial soils are associated with historic ground movement and often exhibit low shear strength. Landslide failure plane(s) could exist within the colluvial strata and may be reactivated when disturbed by excavation or loading associated with trenching or fill placement. Colluvial soil boundaries are illustrated on figures in Appendix B. Further information including the locations of mapped landslide activity is described in Section 2.3.

The soil survey shows that mine spoil exists along portions of the proposed REL alignment, and is derived from surface or underground mining operations. Mine spoils typically consist of excavated soil and rock that was replaced in an uncontrolled manner. The soil survey indicates many areas throughout the northern anthracite coal fields are characteristic of disturbance from mining activities such as strip mining, mine dumps (spoil piles), coal processing, and mines and quarries. Soils pertaining to strip mining and mine spoils is shown on figures in Appendix B between mileposts: 9.61 – 9.75, 9.84 – 9.89, 11.06 – 11.34, 11.47 – 11.60, 11.70 – 11.77, 11.96 – 12.38, 12.50 – 12.80, 12.90 – 13.14, 13.32 – 13.47, 15.30 – 15.70, 15.83 – 15.93, and 16.16 – 16.32.

2.3 Landslides Mapping

CEC used the U.S. Geological Survey, Map MF-771, "Landslide Overview of the Conterminous United States", coupled with LiDAR derivative mapping such as hillshade, to visually evaluate landslide hazards along the proposed pipeline alignments. The USGS publication maps relative incidence of landslides and areas susceptible to landslides indicate regions with slope stability hazards. The mapping review process included evaluation of geologic units and the percentage of area where landslides occurred in each unit. Three categories of incidence of landslides and susceptibility were generated. Units or parts of units having more than 15 percent of their areas involved in landsliding were placed in the category of highest incidence; units having between 15 and 1.5 percent of their areas involved in landsliding were placed in a middle or moderate category; and those with less than 1.5 percent are in a category of lowest incidence. Susceptibility categories were generated based on the probable response of the geologic unit to natural or artificial cutting or loading of slopes or anomalously high precipitation, therefore, are largely subjective. The following table summarizes the designated susceptibility and incidence of landslide occurrence along the lateral and loop alignments.

Mile Point	Susceptibility	Incidence
Regional Energy Lateral		
0.0 – 0.64	Moderate	Moderate
0.64 – 5.47	Low	Low
5.47 – 15.94	High	Moderate
15.94 – 22.34	Low	Low
Effort Loop		
43.71 – 49.4	High	Moderate
49.4 – 57.5	Moderate	Moderate

Information within the published map is highly generalized, due to the lack of precise landslide information during the time of issuance. As such, hillshade imagery was also used to visually identify landslides based on typical morphologic landslide characteristics such as scarps, hummocky topography, and bulging toes. Landslide susceptibility and incidence category boundary evaluation results and LiDAR derived landslides are illustrated on the figures in Appendix B.

2.4 Topography

CEC performed a qualitative review of the proposed alignments topography. This review was performed in conjunction with the review of the other desktop references pertaining to surficial and bedrock geology as discussed throughout this letter report. CEC considered, in a qualitative manner, the potential impact of standard pipeline construction practices on soil and rock strength. The actions of trenching and development of the construction right-of-way have the potential to create situations where relatively strong bedrock or stiff to hard residual soils that existed before construction are replaced with less competent pipeline and restoration backfill, when compared to undisturbed natural soil and bedrock, after construction. CEC also qualitatively considered how typical construction practices have the potential to influence groundwater flow patterns, such as

by potentially concentrating groundwater flow in pipe trenches, in construction and post-construction conditions. Based on these considerations, existing slopes steeper than 2.5H:1V, which may be more susceptible to slope movements after pipeline installation, are illustrated on the Geohazard Figures in Appendix B.

2.5 Bedrock Geology

2.5.1 Stratigraphy

According to the USGS and DCNR online sources, stratigraphic rock units present at or near the surface along the proposed REL pipeline alignment in Luzerne County belong to the Pocono Formation, Spechty Kopf Formation, Duncannon Member of the Catskill Formation, Mauch Chunk Formation, Pottsville Formation, Llewellyn Formation, or the Catskill Formation. The Pocono Formation consists of light-gray to buff or light-olive-gray, medium-grained, crossbedded sandstone and minor siltstone. The Pocono Formation is commonly medial conglomeratic at the base and middle. The Spechty Kopf Formation consists of light to olive-gray, fine to medium grained, crossbedded sandstone, siltstone, and local polymictic diamictite, pebbly mudstone, and laminate, it is generally arranged in crude fining-upward cycles. The Duncannon Member of the Catskill Formation consists of grayish-red sandstone, siltstone, and mudstone in fining-upward cycles with conglomerate occurring at the base of some cycles. The Mauch Chunk Formation consists of grayish-red shale, siltstone, sandstone, and some conglomerate. The Pottsville Formation consists of gray conglomerate, fine- to coarse-grained sandstone, and siltstone and shale containing minable anthracite coals. The Pottsville Formation includes three members, in descending order: Sharp Mountain-conglomerate and conglomeratic sandstone; Schuylkill-sandstone and conglomeratic sandstone; Tumbling Run--conglomeratic sandstone and sandstone. The Llewellyn Formation consists of gray, fine- to coarse-grained sandstone, siltstone, shale, conglomerate, and numerous anthracite coals in repetitive sequences. The Catskill Formation consists of grayish-red sandstone, siltstone, shale, and mudstone. Units of gray sandstone occur in upper part of the Catskill Formation with lithologies arranged in fining-upward cycles. These rock formations are Pennsylvanian, Mississippian, and Devonian in age.

The stratigraphic rock units present at or near the surface along the proposed Effort Loop pipeline alignment in Monroe County belong to the Towamensing Member of the Catskill Formation, Walcksville Member of the Catskill Formation, Trimmers Rock Formation, Mahantango Formation, Marcellus Formation, Beaverdam Run Member of the Catskill Formation, Long Run Member of the Catskill Formation, Poplar Gap Member of the Catskill Formation, or Duncannon member of the Catskill Formation, The Towamensing Member of the Catskill Formation consists of dominantly gray sandstone and some siltstone and shale. The Walcksville Member of the Catskill Formation consists of greenish-gray sandstone and red siltstone and mudstone in fining-upward cycles. The Trimmers Rock Formation consists of olive-gray siltstone and shale, with black shale of the Harrell Formation at its base in the Susquehanna Valley. The Mahantango Formation consists of gray, brown, and olive shale and siltstone. It includes the following members, in descending order: Tully-argillaceous limestone; Sherman Ridge, Montebello (sandstone), Fisher Ridge, Dalmatia, and Turkey Ridge. The Marcellus Formation consists of

black shale; sparse marine fauna and siderite concretions. Tioga bentonite is included at its base in eastern Pennsylvania. The Beaverdam Run Member of the Catskill Formation consists of alternating olive-gray siltstone and sandstone. The Long Run Member of the Catskill Formation consists of gray and grayish-red sandstone and grayish-red siltstone and mudstone in fining-upward cycles. The Poplar Gap Member of the Catskill Formation consists of gray and light-olive-gray sandstone, conglomerate, and siltstone containing intermittent red beds. The Duncannon Member of the Catskill Formation consists of grayish-red sandstone, siltstone, and mudstone in fining-upward cycles; conglomerate occurs at base of some cycles. These rock formations are Devonian in age.

2.5.2 Karst Topography

CEC reviewed DCNR mapping to identify the presence of soluble limestone and karst geologic features indicative of limestone solution. There are no documented karst features such as sinkholes or surface depressions in Luzerne or Monroe County, PA, where the proposed pipelines are located.

2.6 Mining and Coal Conditions

2.6.1 Surface and Deep Mining

The reviewed references indicated extensive deep mining occurred underneath the segment of the REA Lateral pipeline that crosses the northern anthracite coal field between approximate mileposts 9.5 and 16.3. Deep mining occurred in the Red Ash, Ross, Marcy, Pittston, and Lance coal seams. The Lance coal seam is locally known as the Checker seam. In general, these seams were mined between 1880 and 1958 using room and pillar methods. Based on the geologic stratigraphic columns identified in the first progress report for the anthracite coal region, deep mining ranges between 40 feet and 600 feet below the ground surface (bgs). A summary of the coals seam and mining information is presented below:

Coal Seam	Mile Posts Mined	Coal Seam Elevation	Depth of Overburden
Lower Red Ash	11.5 - 13.9	140-150	590
Upper Red Ash	9.7 - 10.5	200-205	540
	11.5 - 12.7	200-205	520
Lower Ross	9.9 - 10.2	210-215	740
	12.7 - 13.7	210-215	400
	14.2 - 16.2	210-215	480
Upper Ross	13.4 - 13.7	260-262	290
Marcy	11.5 - 13.8	330-340	320
	14.2 - 16.2	330-340	350
Pittston	11.6 - 13.8	390-400	180-190
	14.2 - 15.8	390-400	280-290
Lower Lance	11.8 - 13.6	520-680	60-170
Upper Lance	12.2 - 13.4	580-695	40-120

The areas of underground mining are shown on the figures in Appendix B. A generalized stratigraphic column depicting the regional geology relative to the coal seams is included in Appendix D.

According to the USDA soil survey and the PA DEP, Bureau of District Mining Operations, surface mining of the 5 seams has generally occurred along the REL alignment between approximate mileposts 9.61 and 16.32.

2.6.2 Acid Producing Rock

As discussed, the proposed REL pipeline alignments are located in areas that have been previously strip mined and/or deep-mined. Bedrock excavated as part of mining activities commonly possesses characteristics of Acid Producing Rock. The Effort Loop pipeline crosses the Marcellus Formation between approximate mileposts 45.55 to 46.7. The black shales of the Marcellus Formation have been known to cause costly and troublesome problems for construction projects in terms of both acid rock drainage and sulfide-sulfate-induced heave of engineered structures. Therefore, the need to manage APR during pipeline construction activities could be necessary during construction, based on conditions encountered in the field.

2.7 Radioactive Soils/Bedrock

Common sources of radioactivity in soil and rock include uranium-bearing minerals and oxides formed through the action of weathering. The largest concentrations of uranium-bearing minerals occur in organic rich black shales, ultramafic igneous rocks, and soils derived from these sources. Of these potential sources, only shales and shale derived soils are present in the pipeline alignment area. The most common geologic hazard associated with radioactive soils and rock is the occurrence of radon, a naturally occurring product that occurs as an intermediate step in the normal radioactive decay of uranium. Radon is a colorless, odorless gas that can cause health effects due to the release of alpha particles, especially when allowed to accumulate in enclosed spaces. According to the USEPA Map of Radon Zones, the proposed pipeline locations are at an elevated potential risk for radon in indoor air. Radon accumulation in outdoor work areas such as pipe trenches is not anticipated.

2.8 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays. Although coal and coal associated materials with arsenic levels above background may be encountered in the vicinity of the coal seams, the units are weathered and excavation will not generate a great deal of material with potentially elevated arsenic. The process of trenching and backfilling mixes these materials with other non-source soils. This further reduces the risk of arsenic drainage associated with the proposed construction.

Coal seams are not anticipated to be encountered during construction of the proposed REL pipeline; however, as discussed in section 2.6.1 coal mining activities have been identified along the proposed alignment. As such, mine spoil and refuse areas are anticipated to be encountered that may contain arsenic bearing soil or rock associated with coal seams. The mine spoil areas are identified above in section *2.6.1 Surface and Deep Mining.* The mining refuse areas were delineated by the USDA soil survey as soils that are classified as mine spoil, mine dumps, mine wash, or mines and quarries along the proposed REL pipeline alignment.

The Pottsville and the Llewellyn Formations contain stratigraphic units of minable anthracite coal. The proposed REL pipeline alignment crosses the Pottsville and Llewellyn Formations at approximate milepost 9.2 through 16.8. The proposed Effort Loop pipeline alignment crosses the Marcellus Shale Formation between approximate mileposts 45.55 to 46.7. The Marcellus Shale is a black organic-rich shale, pyrite concentrations are common in these types of shales. As such, it is possible that arsenic bearing soils and rock may be encountered.

2.9 Field Geohazard Assessment

In addition to the performance of a desktop reference review, two CEC representatives visited the proposed pipeline alignments and alternate routes between July 27 and July 29, 2020 to observe the site conditions. The field geohazard assessment consisted of traversing the ROW and immediately adjacent areas to observe the existing ground surface conditions and to document evidence of past landsliding events. The field assessment also included identifying potential ground conditions in which disturbance during pipeline construction could result in ground movement. CEC recorded pertinent features such as landslide boundaries, seeps, rock outcrops, apparent areas of colluvium and other site features associated with slope stability or ground movement. These features were recorded using a handheld GPS unit with sub-meter accuracy and are presented on the Geohazard Figures in Appendix B.

CEC observed several features that present an increased risk of slope instability at the time of our reconnaissance which are summarized as follows:

REA Lateral

- Miles 10.83 and 10.95: Potentially unstable benches were observed within the proposed Limit of Disturbance (LOD). Benches appeared to be relic landforms of the past strip mining activity in the area. Throughout this section, multiple drainage channels were observed, which may be indicative of large volumes of surface water during rain events.

Effort Loop

- Miles 44.8 to 44.9: A slope steeper than 2H:1V, was observed. No signs of apparent slope movement were observed.
- Mile 51.93 to 52.0: A slope steeper than 2H:1V having large boulders within the upper reaches of the slope was observed.
- Mile 52.6 to 52.7: A slope as steep as 2H:1V and a slope steeper than 2H:1V, were observed with no signs of apparent slope movement.

3.0 CONCLUSIONS

CEC notes that the opinions presented herein are based on CEC's review of published data and our site reconnaissance. CEC recommends that field conditions be observed by a field representative under the direction of a professional geotechnical engineer during construction to determine if new geohazards have manifested, verify the opinions presented herein, and provide additional recommendations as needed.

3.1 Surficial Geology and Groundwater

3.1.1 Landslides Susceptible Soils

Based on research of landslide susceptible areas at the site and observations made during the field reconnaissance, the proposed pipeline construction could potentially encounter landslide susceptible soils. Pipeline construction in these areas could result in excavations that break the continuity of the slope, fills that could change loading conditions on the slope, and as a result increase the risk of slope instability during and after pipeline construction. The following portions of the pipeline alignment meet this criteria:

REA Lateral

- Miles 3.93 to 3.97
- Miles 6.41 to 6.45
- Miles 6.57 to 6.59
- Miles 8.34 to 8.40
- Miles 10.67 to 10.70
- Miles 10.83 to 10.90
- Miles 10.93 to 11.05
- Miles 14.89 to 14.90
- Miles 16.85 to 16.90

Effort Loop

- Miles 43.71 to 43.72
- Miles 48.32 to 48.49
- Miles 48.51 to 48.61
- Miles 50.40 to 50.46
- Miles 50.72 to 52.0
- Miles 52.22 to 52.25
- Miles 52.92 to 53.56
- Miles 53.94 to 54.26
- Miles 55.07 to 55.18
- Miles 55.68 to 56.05
- Miles 56.38 to 56.83

3.1.2 Side Slope Alignments

Portions of the pipeline alignment are oriented parallel or nearly parallel to the topographic contour of the slope (side slope alignment). During pipeline construction, a level working surface (construction right-of-way) is typically created to support construction equipment and materials. Following pipeline installation, the excavations are backfilled to restore the right-of-way to preconstruction grade. Temporary excavations and fill embankments must be utilized to create the construction right-of-way along a side slope alignment. Temporary excavations break the continuity of the slope and impact surface and groundwater conditions while temporary fill embankments may surcharge landslide susceptible soils. Topographical depressions along sideslopes alignments exacerbate the risk of instability as a result of pipeline construction due to the likelihood of ground and surface water accumulation in the pipeline trench. As a result, side slope alignments can sometimes present an increased risk of instability during and after pipeline construction. The following portions of the pipeline alignment meet this criteria:

REA Lateral

- Miles 2.71 to 2.77
- Miles 6.78 to 6.86
- Miles 6.91 to 6.95
- Miles 8.34 to 8.40
- Miles 10.83 to 10.90
- Miles 10.93 to 11.05
- Miles 19.72 to 19.75
- Miles 19.85 to 19.89
- Miles 20.76 to 20.80

Effort Loop

- Miles 44.15 to 44.18
- Miles 45.19 to 45.26
- Miles 46.69 to 46.72
- Miles 46.81 to 46.84
- Miles 47.05 to 47.08
- Miles 47.67 to 47.70
- Miles 48.33 to 48.48
- Miles 48.98 to 49.05
- Miles 49.80 to 49.82
- Miles 52.21 to 52.29
- Miles 55.13 to 55.30
- Miles 55.83 to 56.05

3.1.3 Steep Slopes

Steep slope areas that were previously stable may become unstable due to excavations and temporary stockpiles made during the installation of pipelines. Each additional pipeline installed will increase the width of excavation and fill placement across the slope. In areas with shallow depth to bedrock, trenching and construction activities will, by necessity, break down the structure of the existing rock. Once the pipeline is installed, the backfill may not have adequate strength without geotechnical treatment to permit reconstruction of the slope at contours of steeper than 2H:1V. Pipeline construction may also impact surface and groundwater conditions in that the pipeline trenches could serve as a likely collection point and conduit for ground water during and after pipeline construction. Temporary soil stockpiling along steep slopes could also increase the risk of surficial sliding and/or mobilizing underlying landslide susceptible soil, if present. The following portions of the pipeline alignment meet this criteria:

REA Lateral

- Miles 2.50 to 2.53
- Miles 3.93 to 3.97
- Miles 4.62 to 4.64
- Miles 6.41 to 6.45
- Miles 6.57 to 6.59
- Miles 7.72 to 7.77
- Miles 8.34 to 8.40
- Miles 8.52 to 8.53
- Miles 8.55 to 8.56
- Miles 8.96 to 8.97
- Miles 11.22 to 11.24
- Miles 11.75 to 11.77
- Miles 12.62 to 12.63
- Miles 14.89 to 14.90
- Miles 16.97 to 16.99
- Miles 18.39 to 18.40

Effort Loop

- Miles 44.80 to 44.90
- Miles 47.75 to 47.81
- Miles 51.94 to 52.01
- Miles 52.67 to 52.70

3.2 Karst

Based on USGS geologic descriptions of the site bedrock formations and available mapping of known karst bedrock, the risk for karst formations in the site soil and bedrock units is minimal. This is due to the irregularity in distribution of susceptible strata (limestones and other carbonate

rocks) and their limited thickness within the site bedrock formations noted in Section 2.5. The lack of mapped karst features in Luzerne and Monroe County, PA also support this conclusion. As such, CEC concludes that the risk of geohazards occurrence resulting from karst conditions is low.

Indications of limited ground surface depressions were observed during the field geohazard assessment at Miles 14.05 to 14.15 where mining activity has not occurred. This area also does not meet the criteria for where karst formations would be anticipated. The depressions appear to be relatively surficial and a result of previous construction activity.

3.3 Mining

The references reviewed indicate that underground mining has been performed beneath portions of the proposed REA Lateral Pipeline. Areas where the pipeline traverses over unmined areas are at no risk for future subsidence. The depth of cover in mined out areas along the alignment ranged from 40 to 600 feet. CEC concludes that where the depth of cover is less than 100 feet and subsidence is not complete, there is a higher risk of subsidence occurring and propagating to the ground surface. CEC also concludes that in areas where the depth of cover is between 100 and 200 feet the risk is moderate and where the depth of cover exceeds 200 feet the risk is low.

Surface mining was also observed during the field geohazard assessment at Miles 16.16 to 16.32. Since the coal has been removed in these areas there is no risk of mine subsidence. Risks in surface mined areas are limited to those associated with APR.

3.4 Acid Producing Rock

Mine spoils and bedrock of the Marcellus Formation will be encountered during pipeline construction. Although potential APR could be present in excavated materials, it will likely be mixed with other soil and rock thereby reducing its concertation and reducing the potential for adverse impacts. If coal or other acid producing rock is encountered in sufficient concentrations it can be mitigated in accordance with PADEP guidelines.

3.5 Radioactive Soils/Bedrock

Based on the information reviewed regarding radioactive soils and bedrock at the site, CEC anticipates that the soils and rock present within the pipeline alignments, in both Luzerne and Monroe Counties, may contain elevated levels of radioactivity in the form of radon. However, the proposed construction activity will not allow for the potential accumulation of radon gas in a confined area indoors, the most common hazard associated with naturally occurring radioactive decay. However, since trenchless installation entry and exit pit excavations are generally more confined areas than long open trenches, special care should be taken to avoid exposure at these locations, if trenchless technologies are utilized.

3.6 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of the natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

Coal mining activities have been identified at various locations along the pipeline route. As such, CEC anticipates the there is an elevated risk of encountering arsenic bearing soils/rock during pipe line construction. However, the process of trenching and backfilling mixes materials with elevated arsenic with other materials that possess background levels of arsenic. This reduces the risk of arsenic impacted drainage associated with the proposed construction activities.

4.0 RECOMMENDATIONS

The following recommendations should be incorporated during pipeline construction to address the identified geohazards within the proposed pipeline ROW.

4.1 Geohazard Areas of Concern

Based on the conclusions presented, the following geohazards warrant, in our opinion, supplemental investigations and potential site specific geohazard mitigation measures during and/or prior to pipeline installation:

REA Lateral

- Miles 10.93 to 11.10: These locations correspond to a side slope alignment in which the topography immediately downslope of the proposed pipeline is steeper than 2H:1V and is located in an area designated as high landslide susceptibility. Potentially unstable benches were also observed during the field geohazard assessment. Evaluate the subsurface conditions encountered during pipeline construction to assess the risk of instability. Determine if implementation of mitigation measures, such as flattening temporary excavation slopes, installing drainage or implementing backfill treatments during construction is necessary to reduce the risk of instability during and after construction based on field conditions.

4.2 Geohazard Mitigation Measures

Based on the conclusions presented, CEC anticipates the following geohazard mitigation measures may be necessary, pending inspection of field conditions under the direction of a professional geotechnical engineer during construction. These measures are specific to providing landslide mitigation in the post construction condition. The following landslide mitigation measures specific to construction conditions may be necessary to execute the work between the approximate mile posts identified.

4.2.1 The Implement of Soil Cement Pipeline Trench Backfill In Accordance With Detail 7 in Attachment C:

Regional Energy Lateral

- Miles 2.50 to 2.53
- Miles 3.93 to 3.97
- Miles 4.62 to 4.64
- Miles 6.41 to 6.45
- Miles 6.57 to 6.59
- Miles 7.72 to 7.77
- Miles 8.34 to 8.40
- Miles 8.52 to 8.53
- Miles 8.55 to 8.56
- Miles 8.96 to 8.97
- Miles 11.22 to 11.24
- Miles 11.75 to 11.77
- Miles 12.62 to 12.63
- Miles 14.89 to 14.90
- Miles 16.97 to 16.99
- Miles 18.39 to 18.40

Effort Loop

- Miles 44.80 to 44.90
- Miles 47.75 to 47.81
- Miles 51.94 to 52.01
- Miles 52.67 to 52.70

4.2.2 Install Pipelines Within A Competent Soil and/or Bedrock Trench:

Regional Energy Lateral

- Miles 3.93 to 3.97
- Miles 6.41 to 6.45
- Miles 6.57 to 6.59
- Miles 8.34 to 8.40
- Miles 10.67 to 10.70
- Miles 10.83 to 10.90
- Miles 10.93 to 11.05
- Miles 14.89 to 14.90
- Miles 16.85 to 16.90

Effort Loop

- Miles 43.71 to 43.72
- Miles 48.32 to 48.49

- Miles 48.51 to 48.61
- Miles 50.40 to 50.46
- Miles 50.72 to 52.0
- Miles 52.22 to 52.25
- Miles 52.92 to 53.56
- Miles 53.94 to 54.26
- Miles 55.07 to 55.18
- Miles 55.68 to 56.05
- Miles 56.38 to 56.83

A high percentage of landslide along a pipeline alignment can be attributed to uncontrolled surface and ground water. Surface water best management practices should be implemented according to the erosion and sedimentation control plans for controlling soil erosion thereby reducing the risk of slope instability. Groundwater buildup along the pipeline alignment could result in excess pore pressures, resulting in potential slope instability. CEC observed several locations where erosional features and topographical depressions would suggest that ground water will be encountered during or after construction. These observations concerning existing ground water indicate the potential need for supplementary drainage measures to be added along segments of the pipeline alignment. Installation of subsurface drainage, in general accordance with Geohazard Mitigation Details included in Appendix C, may be required at the following locations, pending inspection of field conditions during construction under the direction of a professional geotechnical engineer:"

Regional Energy Lateral

- Miles 2.71 to 2.77 (Detail 5)
- Miles 3.93 to 3.94 (Detail 1 and Detail 3)
- Miles 3.95 to 3.97 (Detail 1 and Detail 3)
- Miles 4.62 to 4.64 (Detail 1 and Detail 3)
- Miles 6.41 to 6.45 (Detail 1 and Detail 3)
- Miles 6.57 to 6.59 (Detail 1 and Detail 3)
- Miles 6.78 to 6.86 (Detail 5)
- Miles 6.91 to 6.95 (Detail 5)
- Miles 8.34 to 8.40 (Detail 5)
- Miles 10.67 to 10.70 (Detail 1 and Detail 3)
- Miles 10.83 to 10.90 (Detail 5)
- Miles 10.93 to 11.05 (Detail 5)
- Miles 11.22 to 11.24 (Detail 1 and Detail 3)
- Miles 11.75 to 11.77 (Detail 1 and Detail 3)
- Miles 12.62 to 12.63 (Detail 1 and Detail 3)
- Miles 14.89 to 14.90 (Detail 1 and Detail 3)
- Miles 18.32 to 18.33 (Detail 1 and Detail 3)
- Miles 19.72 to 19.75 (Detail 5)
- Miles 19.85 to 19.89 (Detail 5)
- Miles 20.10 to 20.17 (Detail 5)

- Miles 21.08 to 21.19 (Detail 5)

Effort Loop

- Miles 44.15 to 44.18 (Detail 5)
- Miles 44.82 to 44.89 (Detail 1 and Detail 4)
- Miles 45.19 to 45.26 (Detail 5)
- Miles 46.69 to 46.72 (Detail 5)
- Miles 46.81 to 46.84 (Detail 5)
- Miles 47.06 to 47.08 (Detail 5)
- Miles 47.67 to 47.70 (Detail 5)
- Miles 47.75 to 47.81 (Detail 1 and Detail 4)
- Miles 48.33 to 48.48 (Detail 5)
- Miles 48.98 to 49.05 (Detail 5)
- Miles 49.8 to 49.82 (Detail 5)
- Miles 51.91 to 52.07 (Detail 1, Detail 3, and Detail 4)
- Miles 52.21 to 52.29 (Detail 5)
- Miles 52.67 to 52.70 (Detail 1 and Detail 3)
- Miles 55.13 to 55.3 (Detail 5)
- Miles 55.83 to 56.04 (Detail 5)

4.3 Mine Subsidence Mitigation

In the following area, the depth of overburden between the ground surface and underground mine workings was less than 100 feet:

Regional Energy Lateral

- Miles 11.8 to 13.6

CEC recommends that additional monitoring be performed during construction, specifically in areas where the depth to the mine is less than 50 feet, to determine mine and roof rock conditions. Depending on mine and roof rock conditions, it may be necessary to confirm the pipeline can safely span potential subsidence locations/lengths. Typically, though, the pipeline can be designed to span potential mine subsidence lengths, based on historic subsidence observations. Alternatively, other mine stabilization measures may be employed to reduce the risk of mine subsidence propagating to the surface and affecting the pipeline. These measures include purposely subsiding known features via focused blasting and subsequent backfilling, backfilling mine hazards with coarse aggregate that may contain a binder (e.g. cement) to stabilize the backfill within mine workings, or the use of injection grouting to fill voids or bind zones of collapsed rubble or gob. If mine subsidence or sinkholes occur during construction or post-construction, they can be mitigated on an as-needed basis using the typical mitigation measures included in Appendix C and referenced by PADEP Erosion and Sediment Pollution Control Program Manual, Technical Guidance Number 363-2134-008; Chapter 17 – Areas of Special Concern; Sinkhole Repair .

4.4 Oversight and Monitoring

4.4.1 Construction Oversight

The data collected and opinions presented in this report are based on CEC's review of published documents and the limited insight into the site surface and subsurface conditions that could be garnered during our field geohazard assessment. CEC recommends having geotechnical personnel on-site during construction in areas where geohazard mitigation measures are recommended. This allows a geotechnical engineer to evaluate the actual subsurface conditions encountered during construction, assess the appropriateness of the recommendations, modify recommendations when required, modify the locations of mitigation measures where required, and confirm CEC's recommendations are being correctly implemented.

5.0 POST-CONSTRUCTION MONITORING

CEC recommends that AOIs described herein and additional AOIs generated during construction are visually monitored by trained personnel under the supervision of a geotechnical engineer for signs of instability until vegetation has stabilized. Visually monitoring should be performed within 24-hours of a rainfall event under the permit requirement and two times per month at a minimum. CEC assumes that the pipeline right-of-way will be monitored by Transco environmental inspectors following rainfall events.

Field conditions related to landslides and mine induced subsidence features can evolve over long periods of time. CEC recommends periodic monitoring of field conditions in areas of steep slopes and areas where the depth to mining exceeds 100 feet within the ROW to limit the potential for geohazards to threaten pipeline assets. Periodic monitoring of steep slopes and subsidence features can be conducted concurrently with other asset inspections.

6.0 STANDARD OF CARE AND REPORT LIMITATIONS

This letter report was prepared for the purpose of design review. Reliance on this letter report by any party other than Transco or its authorized agents is expressly forbidden. Contractors should not rely on the conclusions and interpretations in this letter report for purposes 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 this opportunity to be of service to Transco. Please call if you have any questions or comments.

Very truly yours,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Kuchanda I. Dy, P.E.
Assistant Project Manager

Michael L. Schumaker, P.E.
Principal

Appendix A – Important Information about This Geotechnical-Engineering Report
Appendix B – Geohazard Figures
Appendix C – Geohazard Mitigation Details
Appendix D – Stratigraphic Columns

303-105-LR-GEOT-REV-11.24.20

APPENDIX 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 not 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 Not 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

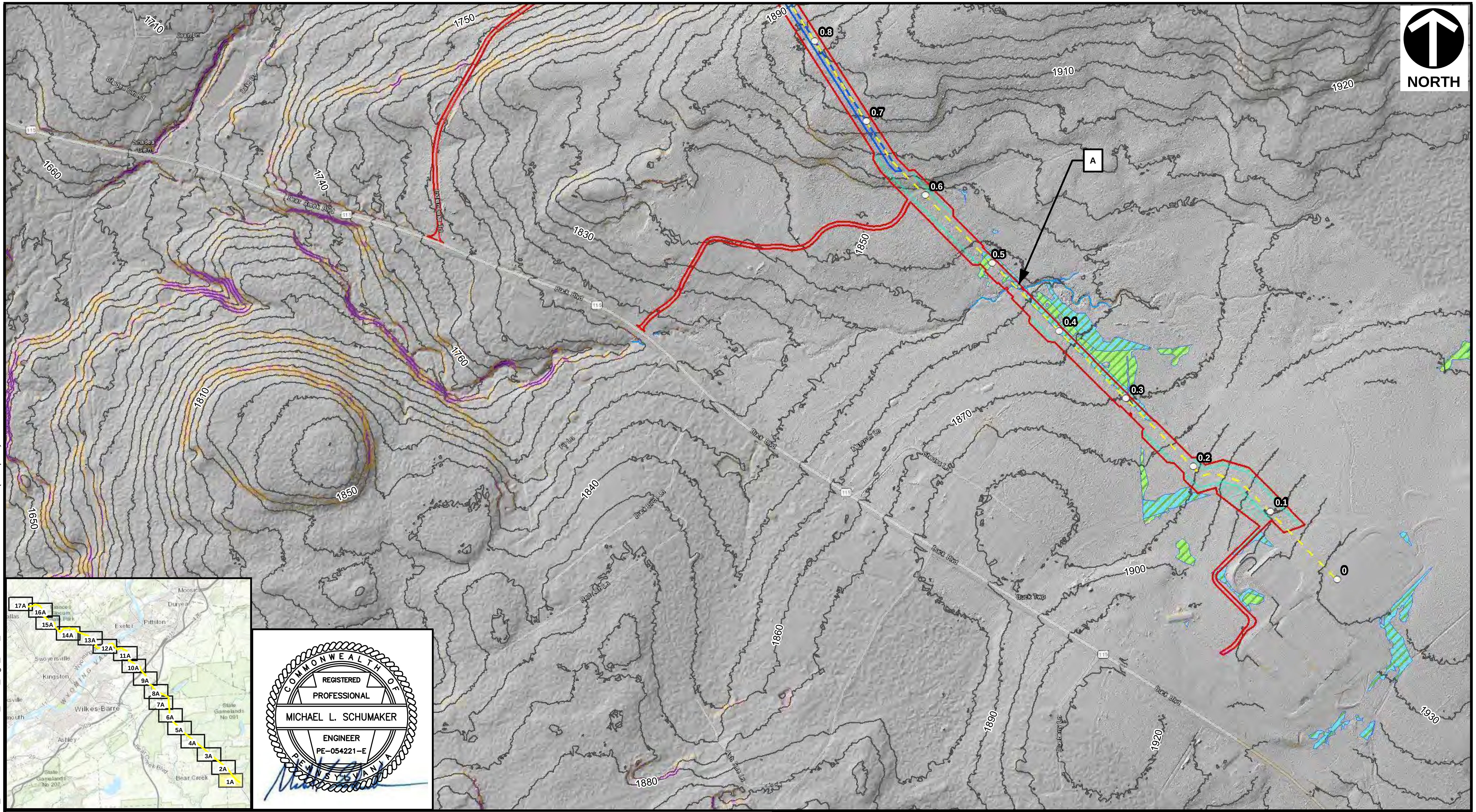
While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not 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 not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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

APPENDIX B

GEOHAZARD FIGURES



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LEGEND

- MILE POST
- PROPOSED ALIGNMENT
- GPS COLLECTED FEATURE
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- PERMANENT RIGHT OF WAY
- PROPOSED TEMPORARY WORKSPACE
- PROPOSED ADDITIONAL TEMPORARY WORKSPACE
- PROPOSED FACILITIES/ SITES
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- DEEP MINED AREA
- WETLAND
- WATERBODY
- STREAM
- INDEX CONTOUR - 10 FT
- MINE ENTRY POINT/OPENING
- PROPOSED DRAIN LOCATIONS

REFERENCES

1. RADBRUCH-HALL & OTHERS, 1976, LANDSLIDE OVERVIEW OF THE CONTERMINOUS UNITED STATES, U.S. GEOLOGICAL SURVEY, MAP MF-771
2. U.S.D.A. SOIL SURVEY GEOGRAPHIC (SSURGO) DATABASE FOR LAZURNE COUNTY, PENNSYLVANIA, 2015
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5. ENVIRONMENTAL FEATURES, PIPELINE ALIGNMENT, AND RELATED CONTENT PROVIDED BY WOOD GROUP SHARE POINT TITLED "Williams REA 242581"

SCALE IN FEET

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KEY NOTES

- A FURNISH AND INSTALL DRAINED TRENCH PLUG PER DETAIL 1, SHEET GT01
- B FURNISH AND INSTALL SLOPE TOE DRAIN OUTLET PER DETAIL 3, SHEET GT01
- C FURNISH AND INSTALL WATERBAR TRENCH DRAIN OUTLET PER DETAIL 4, SHEET GT01
- D FURNSIH AND INSTALL SIDE SLOPE TRENCH DRAIN PER DETAIL 5, SHEET GT01 AS NEEDED WITHIN TOPOGRAPHICAL AND PIPELINE TRENCH SAGS. OUTLET DRAIN LOCATIONS(S) TO BE DETERMINED IN THE FIELD DURING CONSTRUCTION

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LUZERNE AND MONROE COUNTIES
PENNSYLVANIA

REGIONAL ENERGY LATERAL GEOHAZARD ASSESSMENT

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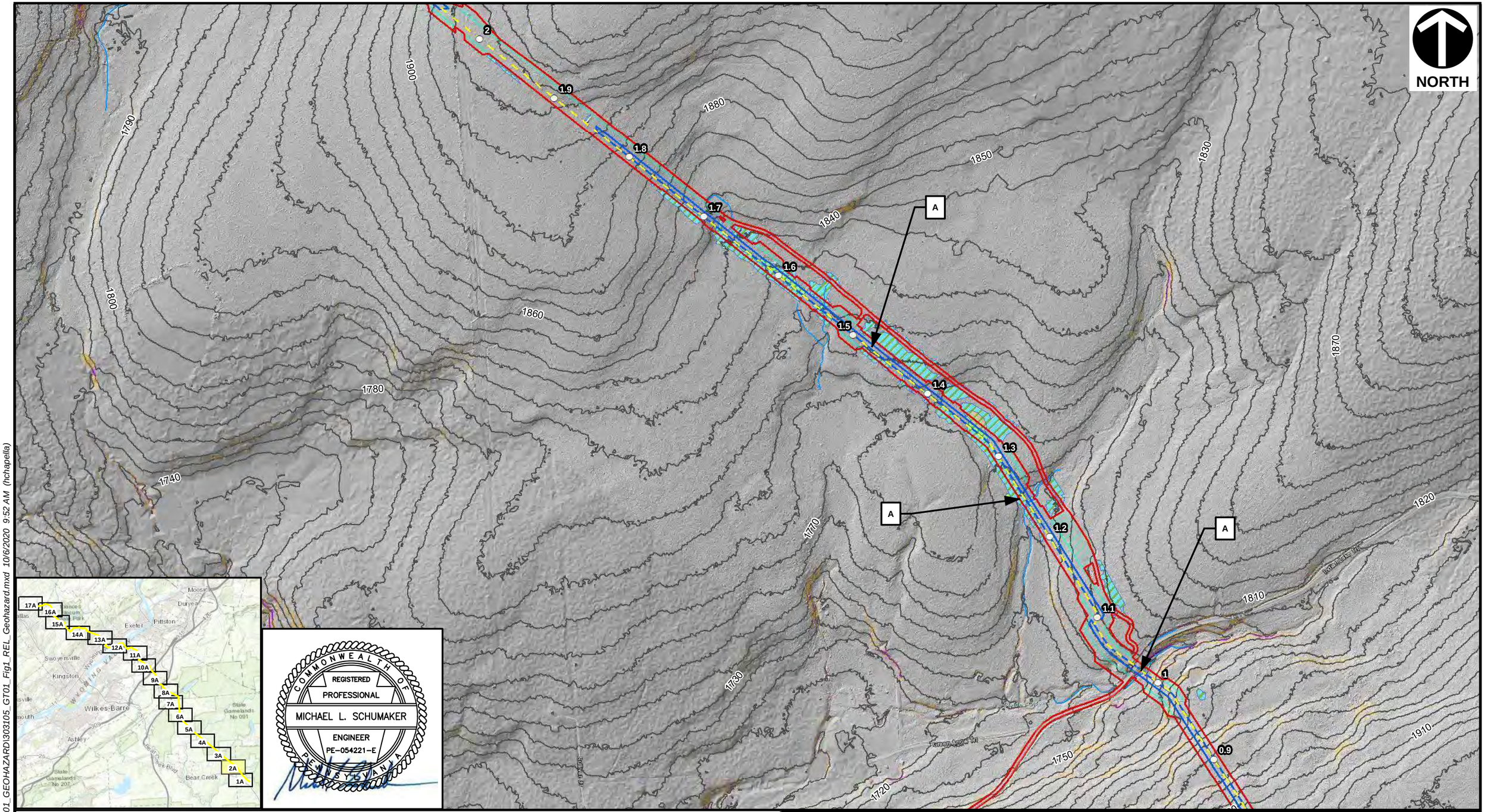

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ENGINEER
PE-054221-E

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REGIONAL ENERGY LATERAL GEOHAZARD ASSESSMENT

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NORTH

STEEP SLOPE RECONSTRUCTION
DETAIL 7

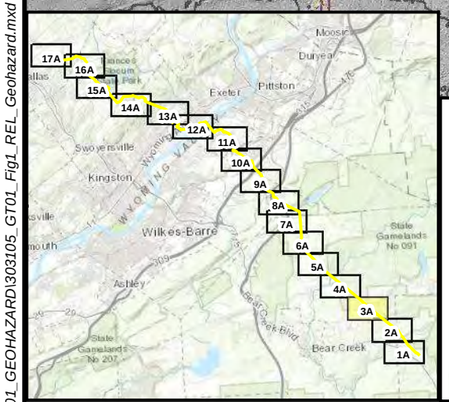

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FIGURE NO: **3A**

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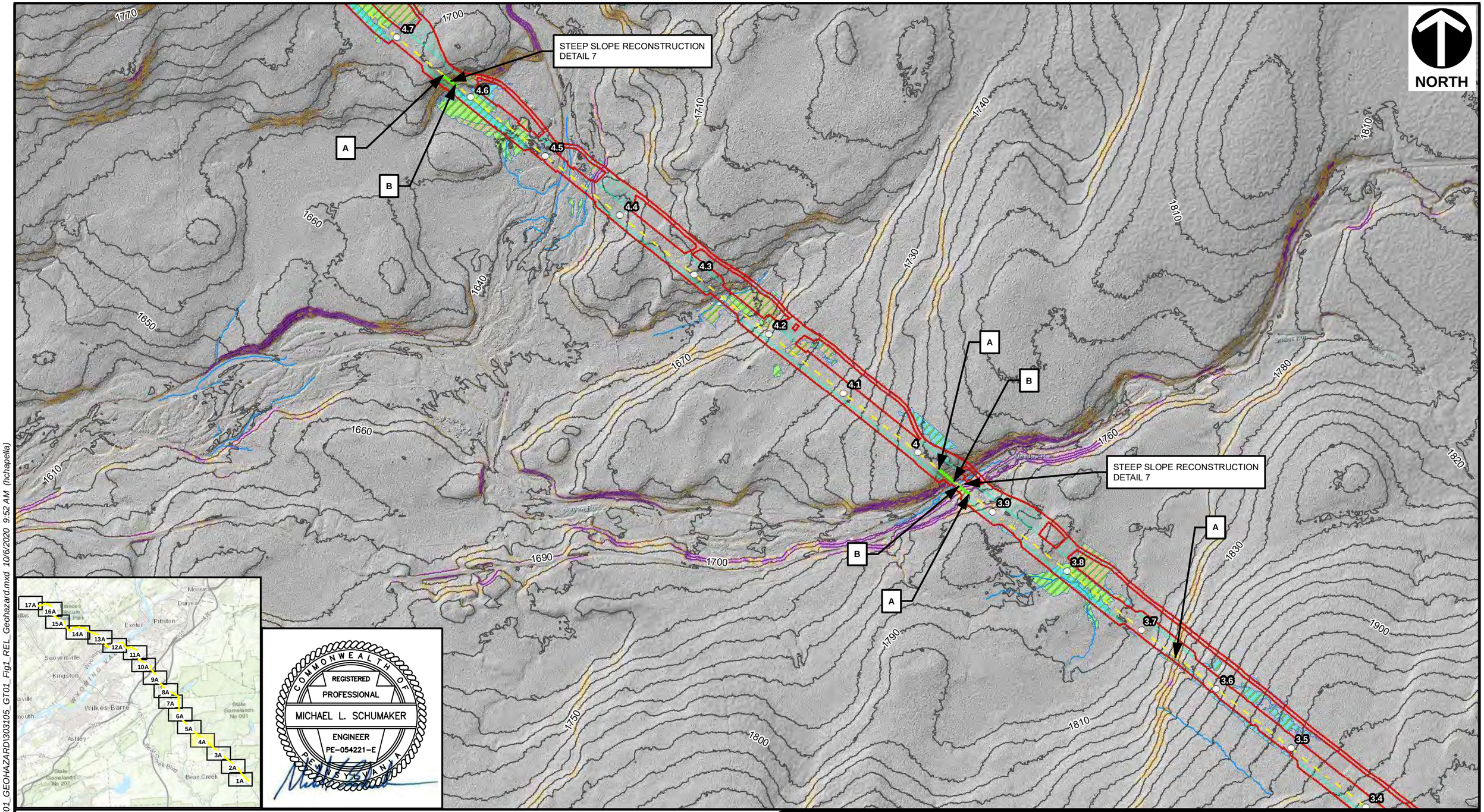

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SCALE IN FEET
0 500 1,000

KEY NOTES

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- C FURNISH AND INSTALL WATERBAR TRENCH DRAIN OUTLET PER DETAIL 4, SHEET GT01
- D FURNSIH AND INSTALL SIDE SLOPE TRENCH DRAIN PER DETAIL 5, SHEET GT01 AS NEEDED WITHIN TOPOGRAPHICAL AND PIPELINE TRENCH SAGS. OUTLET DRAIN LOCATIONS(S) TO BE DETERMINED IN THE FIELD DURING CONSTRUCTION

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DATE:	10/6/2020	SCALE:	1 " = 500 '	PROJECT NO:	303-105

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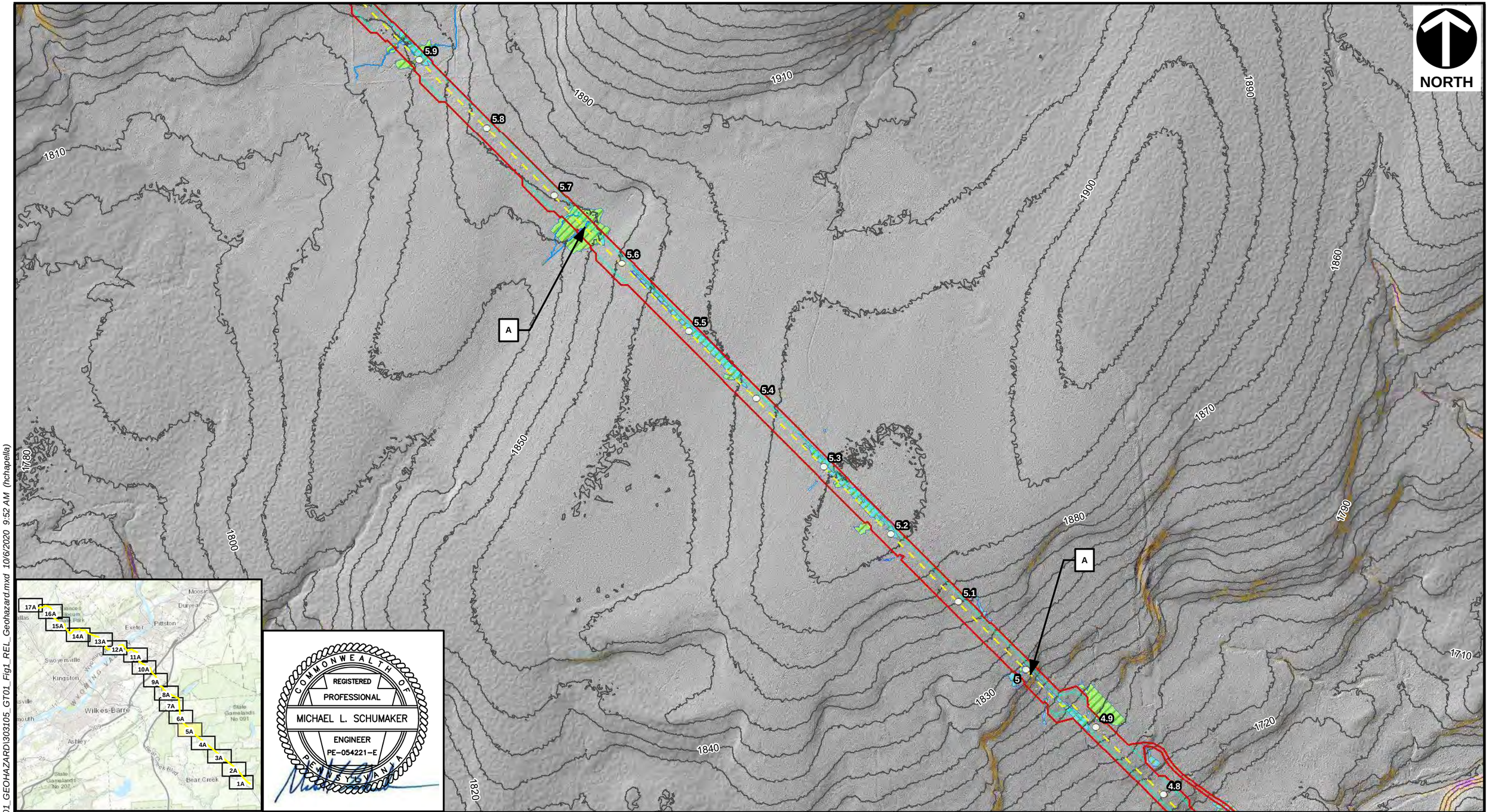

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REGISTERED PROFESSIONAL
MICHAEL L. SCHUMAKER
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PE-054221-E

LEGEND

- MILE POST
- PROPOSED ALIGNMENT
- GPS COLLECTED FEATURE
- PROPOSED LIMIT OF DISTURBANCE
- PERMANENT RIGHT OF WAY
- PROPOSED TEMPORARY WORKSPACE
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- WATERBODY
- STREAM
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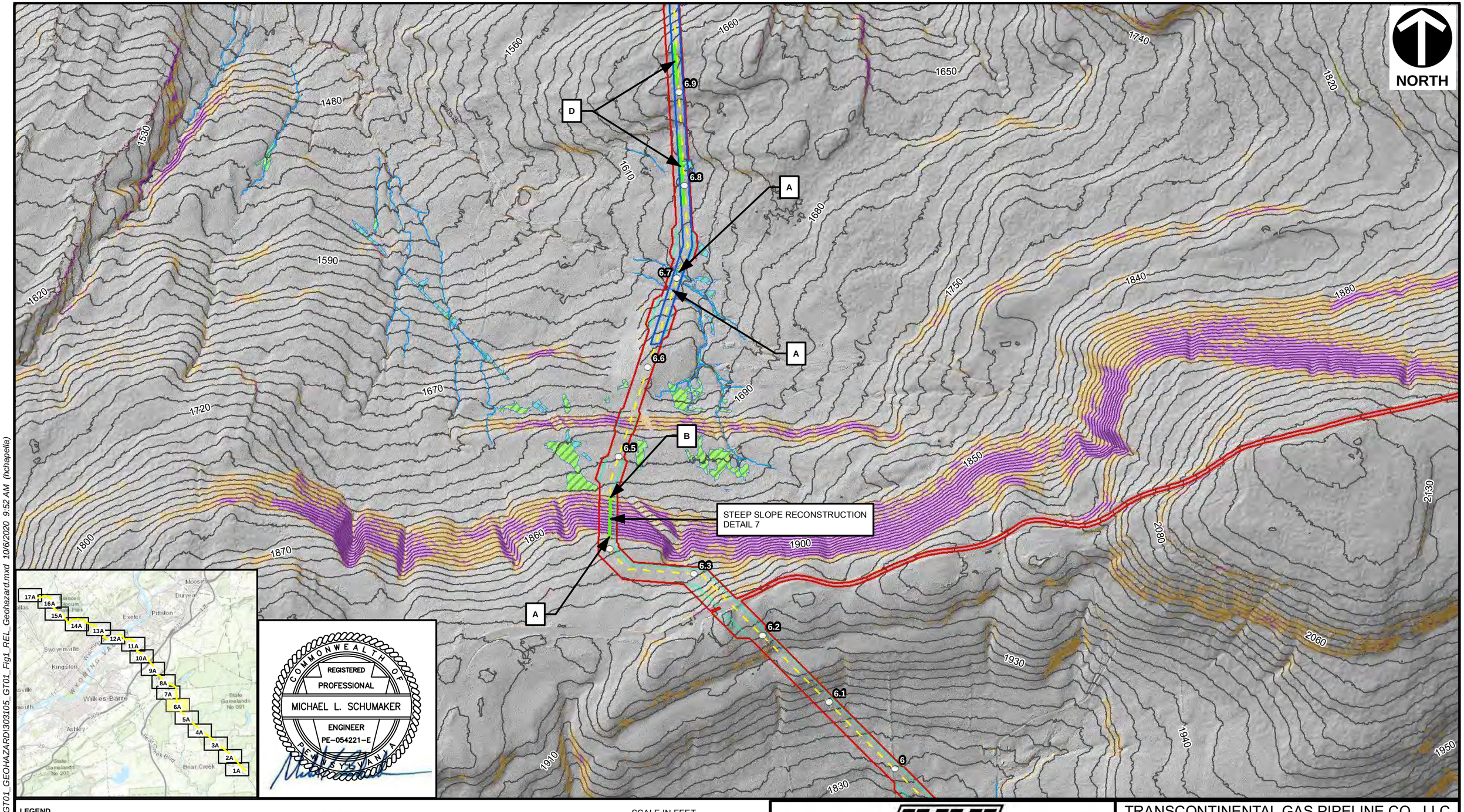

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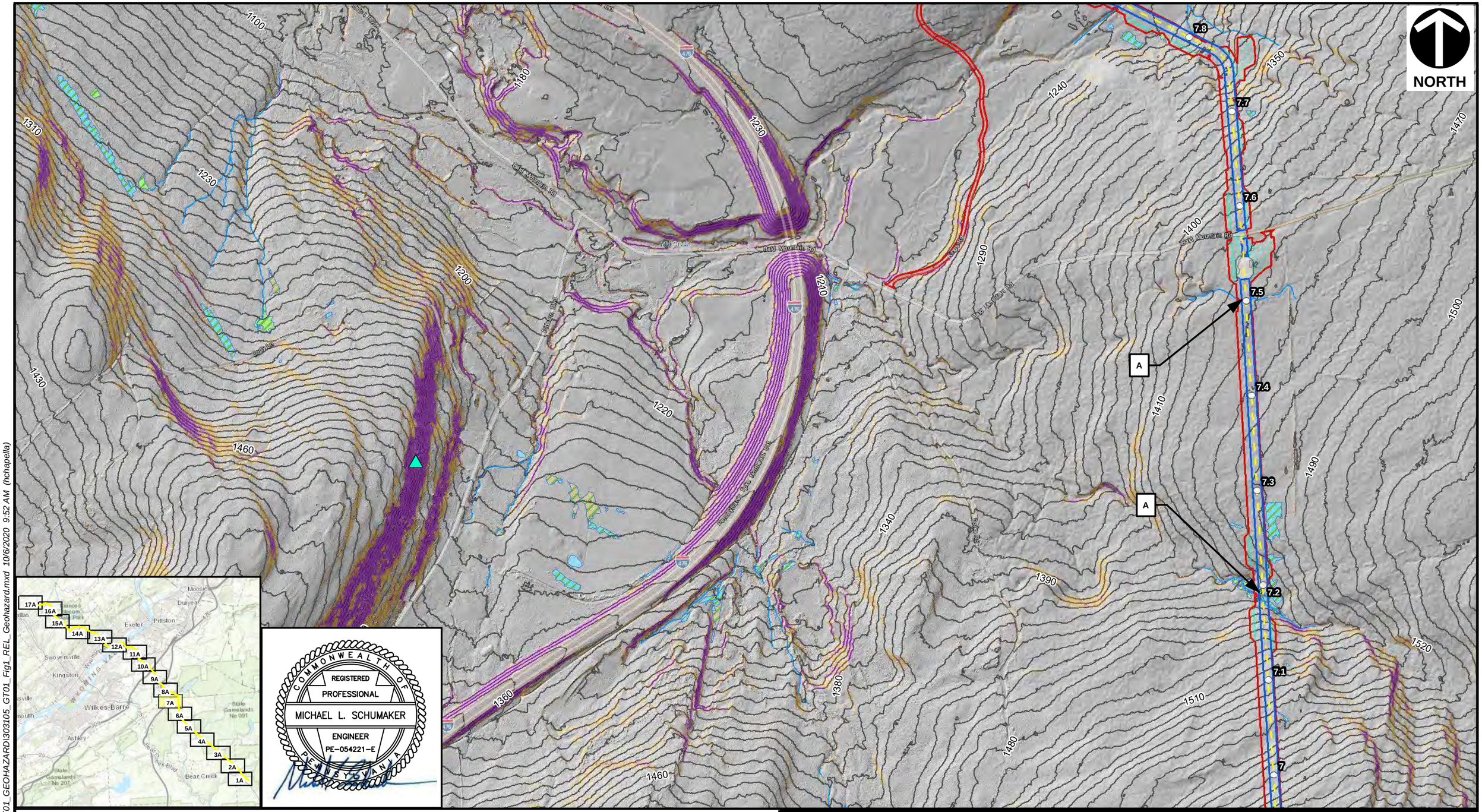

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STEEP SLOPE RECONSTRUCTION DETAIL 7

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STEEP SLOPE RECONSTRUCTION DETAIL 7

NORTH

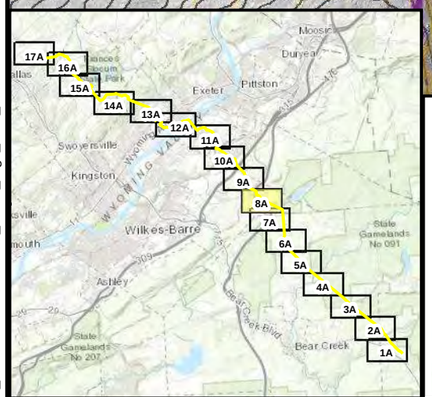

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FIGURE NO: **8A**

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NORTH

MINE SPOIL POTENTIALLY REQUIRING ACID PRODUCING ROCK (APR) PLAN

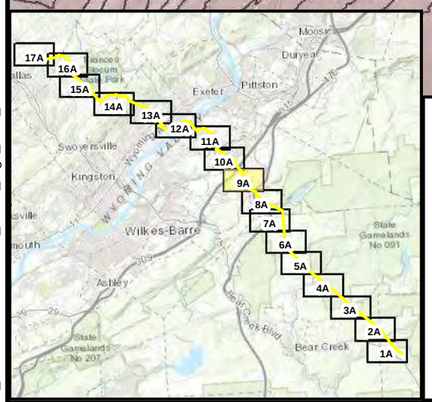

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FIGURE NO: **9A**

NORTH

HUMMOCKY SLOPE

STEEP SLOPE RECONSTRUCTION DETAIL 7

DRAINAGE SWALE

POTENTIALLY UNSTABLE BENCH

ABANDONED MINE ENTRY HEIGHT UNKNOWN

MINE SPOIL POTENTIALLY REQUIRING ACID PRODUCING ROCK (APR) PLANS

STEEP SLOPE RECONSTRUCTION DETAIL 7

STEEP SLOPE RECONSTRUCTION DETAIL 7

11.6 11.5 11.4 11.3 11.2 11.1 11 10.9 10.8 10.7 10.6 10.5 10.4 10.3

A B C D

740 760 770 730 790 910 950 980 970 840 820 800 920 930 810 940 830 900 960 850

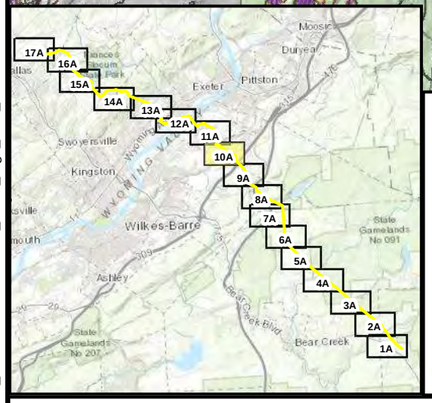

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FIGURE NO: **10A**

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ABANDONED MINE ENTRY
HEIGHT UNKNOWN

RECLAIMED VERTICAL MINE SHAFT
HEIGHT OF 30 FT

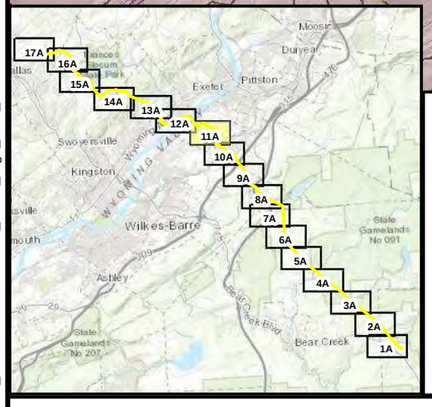
MINE SPOIL POTENTIALLY REQUIRING
ACID PRODUCING ROCK (APR) PLANS

STEEP SLOPE RECONSTRUCTION
DETAIL 7

RECLAIMED MINE ENTRY
HEIGHT OF 300 FT

STEEP SLOPE RECONSTRUCTION
DETAIL 7

NORTH



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- A FURNISH AND INSTALL DRAINED TRENCH PLUG PER DETAIL 1, SHEET GT01
- B FURNISH AND INSTALL SLOPE TOE DRAIN OUTLET PER DETAIL 3, SHEET GT01
- C FURNISH AND INSTALL WATERBAR TRENCH DRAIN OUTLET PER DETAIL 4, SHEET GT01
- D FURNSIH AND INSTALL SIDE SLOPE TRENCH DRAIN PER DETAIL 5, SHEET GT01 AS NEEDED WITHIN TOPOGRAPHICAL AND PIPELINE TRENCH SAGS. OUTLET DRAIN LOCATIONS(S) TO BE DETERMINED IN THE FIELD DURING CONSTRUCTION

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PENNSYLVANIA

REGIONAL ENERGY LATERAL GEOHAZARD ASSESSMENT

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DATE:	10/6/2020	SCALE:	1 " = 500 '	PROJECT NO:	303-105

FIGURE NO: **11A**

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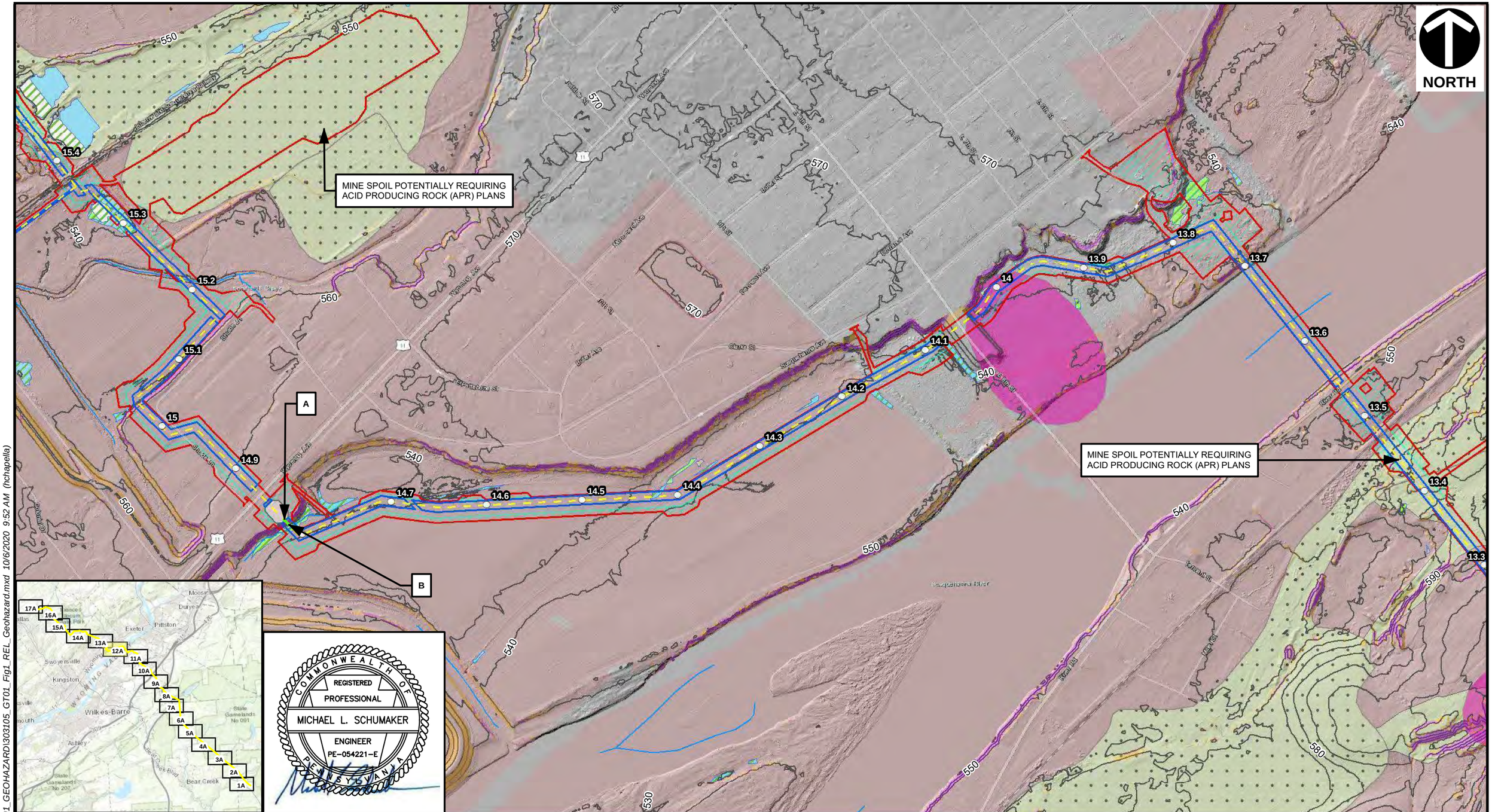

LEGEND

- MILE POST
- PROPOSED ALIGNMENT
- GPS COLLECTED FEATURE
- PROPOSED LIMIT OF DISTURBANCE
- PERMANENT RIGHT OF WAY
- PROPOSED TEMPORARY WORKSPACE
- PROPOSED ADDITIONAL TEMPORARY WORKSPACE
- PROPOSED FACILITIES/ SITES
- SLOPES 3H:1V - 2H:1V
- SLOPES STEEPER THAN 2H:1V
- SUBSIDENCE PRONE AREA
- STRIP MINE
- MINE SPOIL
- QUARRIES
- DEEP MINED AREA
- WETLAND
- WATERBODY
- STREAM
- INDEX CONTOUR - 10 FT
- MINE ENTRY POINT/OPENING
- PROPOSED DRAIN LOCATIONS

REFERENCES

1. RADBRUCH-HALL & OTHERS, 1976, LANDSLIDE OVERVIEW OF THE CONTERMINOUS UNITED STATES, U.S. GEOLOGICAL SURVEY, MAP MF-771
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5. ENVIRONMENTAL FEATURES, PIPELINE ALIGNMENT, AND RELATED CONTENT PROVIDED BY WOOD GROUP SHARE POINT TITLED "Williams REA 242581"

SCALE IN FEET

0 500 1,000

KEY NOTES

- A FURNISH AND INSTALL DRAINED TRENCH PLUG PER DETAIL 1, SHEET GT01
- B FURNISH AND INSTALL SLOPE TOE DRAIN OUTLET PER DETAIL 3, SHEET GT01
- C FURNISH AND INSTALL WATERBAR TRENCH DRAIN OUTLET PER DETAIL 4, SHEET GT01
- D FURNSIH AND INSTALL SIDE SLOPE TRENCH DRAIN PER DETAIL 5, SHEET GT01 AS NEEDED WITHIN TOPOGRAPHICAL AND PIPELINE TRENCH SAGS. OUTLET DRAIN LOCATIONS(S) TO BE DETERMINED IN THE FIELD DURING CONSTRUCTION

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DATE:	10/6/2020	SCALE:	1 " = 500 '	PROJECT NO: 303-105	

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COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

LEGEND

- MILE POST
- PROPOSED ALIGNMENT
- GPS COLLECTED FEATURE
- PROPOSED LIMIT OF DISTURBANCE
- PERMANENT RIGHT OF WAY
- PROPOSED TEMPORARY WORKSPACE
- PROPOSED ADDITIONAL TEMPORARY WORKSPACE
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- WATERBODY
- STREAM
- INDEX CONTOUR - 10 FT
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- PROPOSED DRAIN LOCATIONS

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SCALE IN FEET
0 500 1,000

KEY NOTES

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FIGURE NO: **13A**

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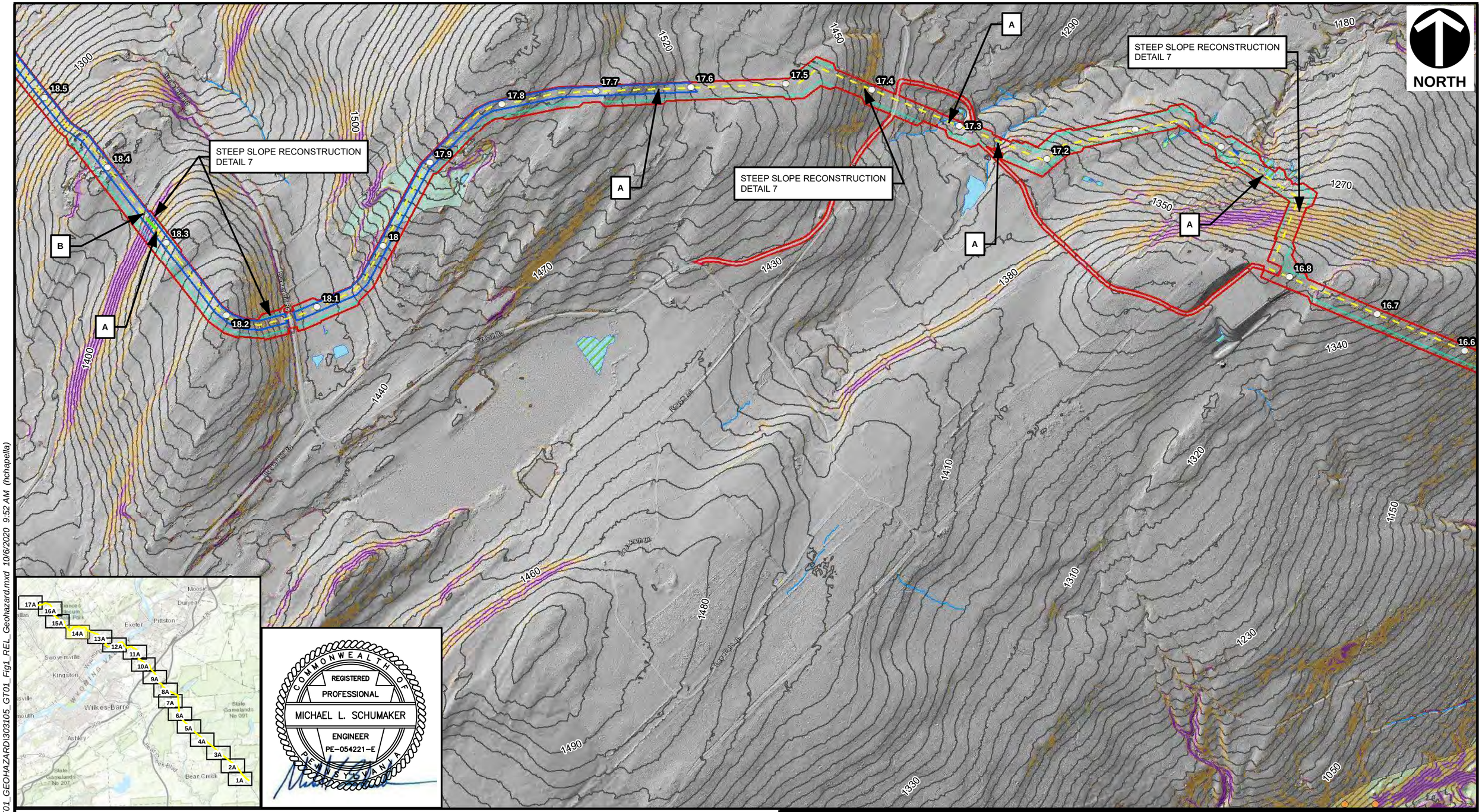

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
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ENGINEER
PE-054221-E

LEGEND

- MILE POST
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- MINE ENTRY POINT/OPENING
- PROPOSED DRAIN LOCATIONS

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SCALE IN FEET
0 500 1,000

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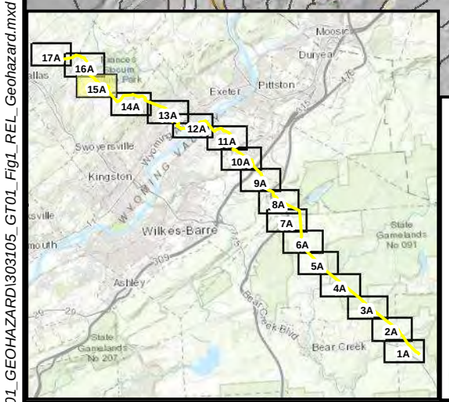
NORTH

STEEP SLOPE RECONSTRUCTION
DETAIL 7



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MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

LEGEND

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- STREAM
- INDEX CONTOUR - 10 FT
- MINE ENTRY POINT/OPENING
- PROPOSED DRAIN LOCATIONS

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SCALE IN FEET
0 500 1,000

KEY NOTES

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- C: FURNISH AND INSTALL WATERBAR TRENCH DRAIN OUTLET PER DETAIL 4, SHEET GT01
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DATE:	10/6/2020	SCALE:	1 " = 500 '	PROJECT NO:	303-105

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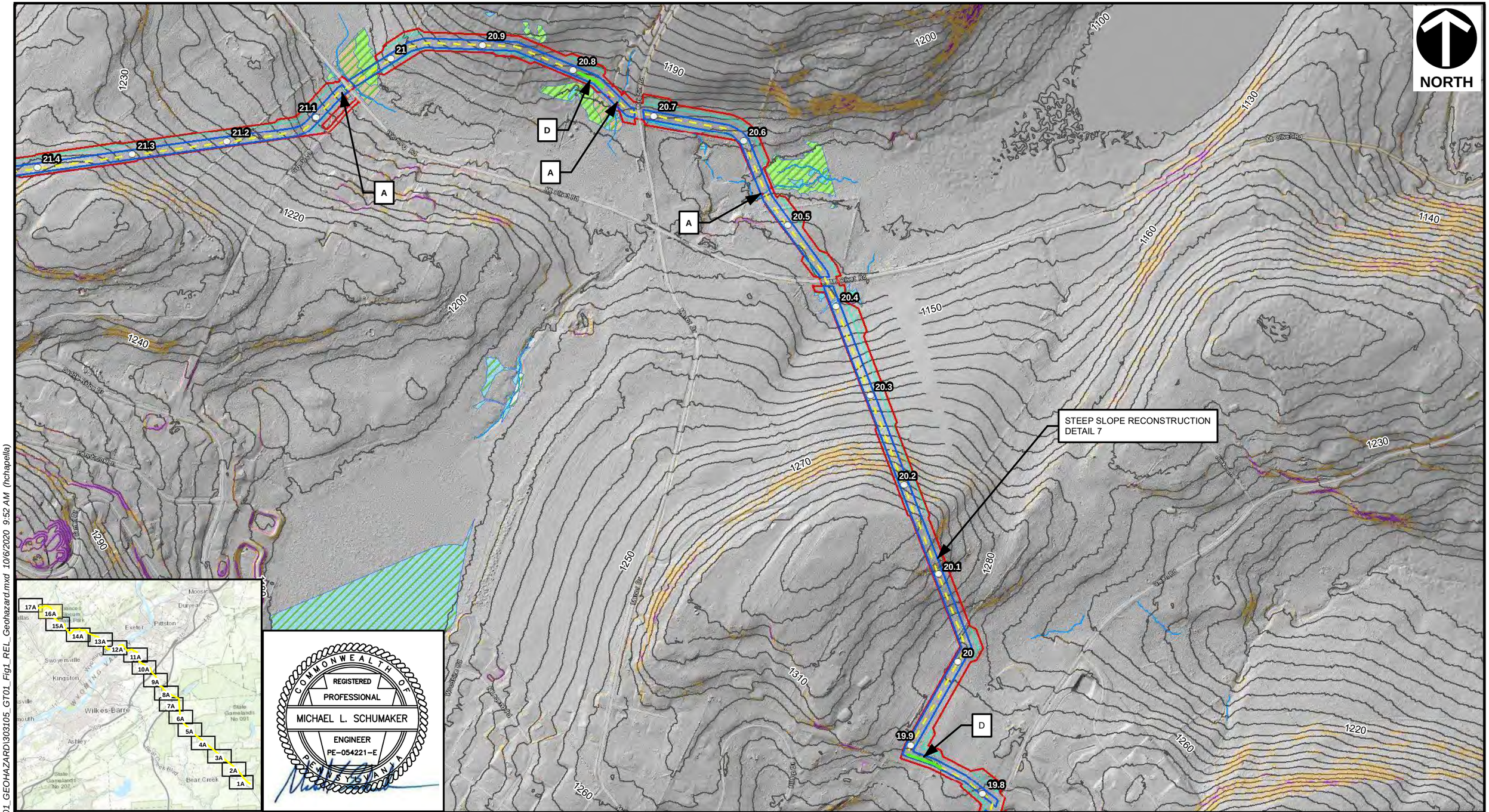
PENNSYLVANIA

REGIONAL ENERGY LATERAL GEOHAZARD ASSESSMENT

FIGURE NO: **15A**



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ENGINEER
PE-054221-E

LEGEND

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- PROPOSED LIMIT OF DISTURBANCE
- PERMANENT RIGHT OF WAY
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SCALE IN FEET
0 500 1,000

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REGIONAL ENERGY LATERAL GEOHAZARD ASSESSMENT

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FIGURE NO: **16A**

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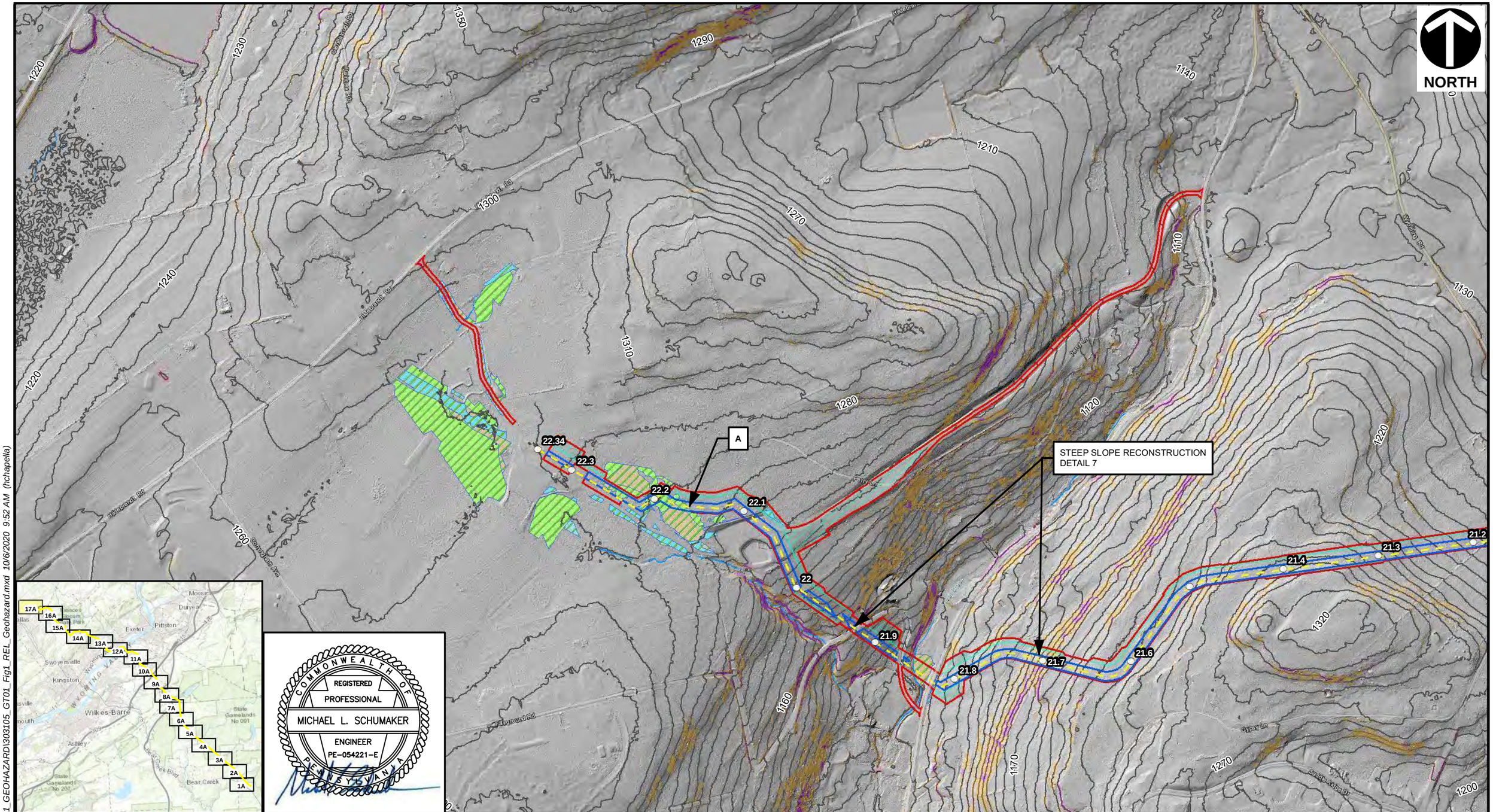

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

LEGEND

- MILE POST
- PROPOSED ALIGNMENT
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SCALE IN FEET
0 500 1,000

KEY NOTES

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REGIONAL ENERGY LATERAL GEOHAZARD ASSESSMENT

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DATE:	10/6/2020	SCALE:	1 " = 500 '	PROJECT NO:	303-105

FIGURE NO: **17A**

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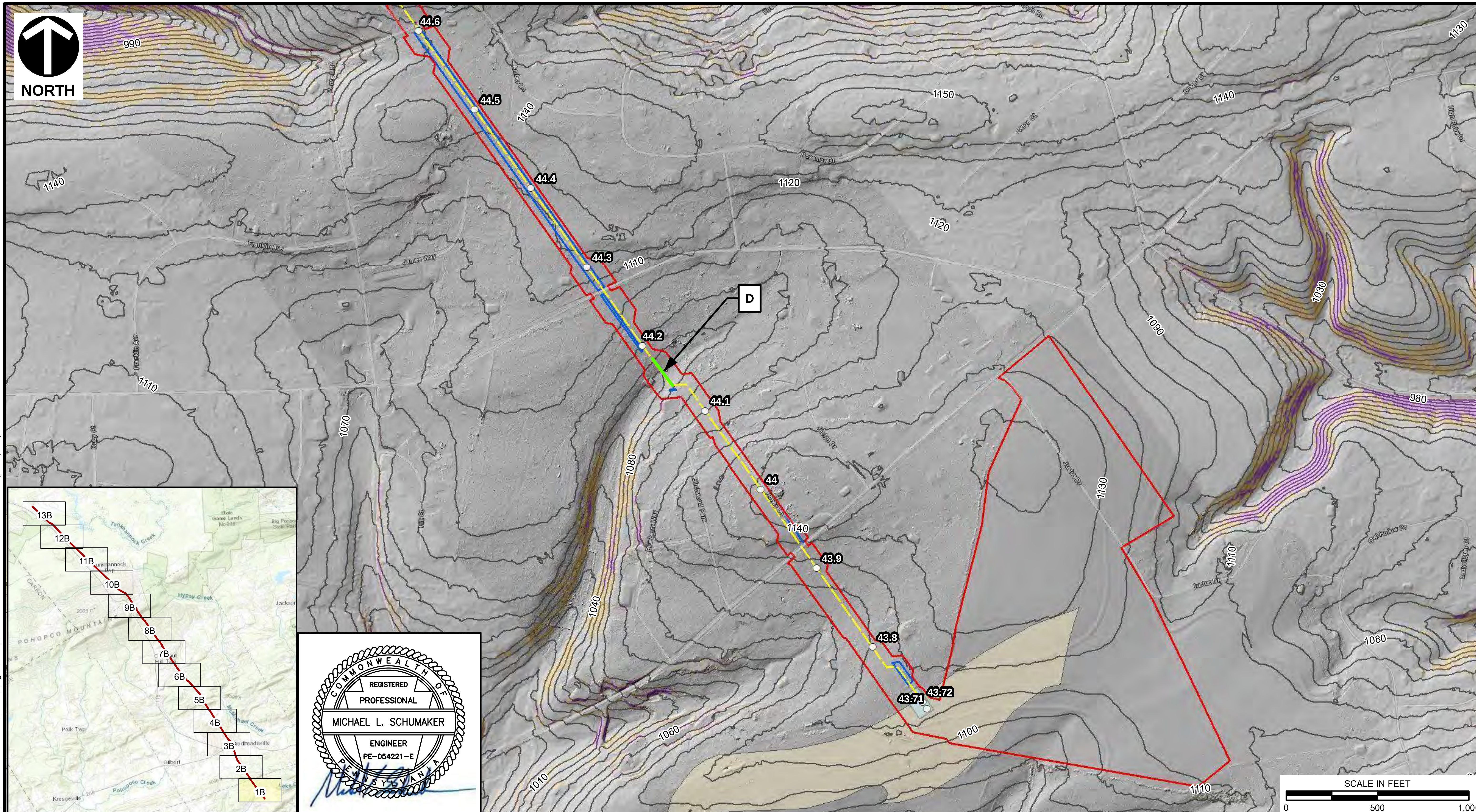

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LEGEND

MILE POST	SLOPES STEEPER THAN 2H:1V
PROPOSED ALIGNMENT	DEEP MINED AREA*
PERMANENT RIGHT-OF-WAY	PALUSTRINE EMERGENT
PROPOSED LIMIT-OF-DISTURBANCE	PALUSTRINE FORESTED
EXISTING FACILITY	PALUSTRINE SCRUB SHRUB
COLLUVIAL SOIL	STREAM
GRAVEL PIT	INDEX CONTOUR - 10 FT
SLOPES 3H:1V - 2H:1V	PROPOSED DRAIN LOCATIONS

KEY NOTES

A. FURNISH AND INSTALL DRAINED TRENCH PLUG PER DETAIL 1, SHEET GT01

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PENNSYLVANIA

EFFORT LOOP
GEOHAZARD ASSESSMENT

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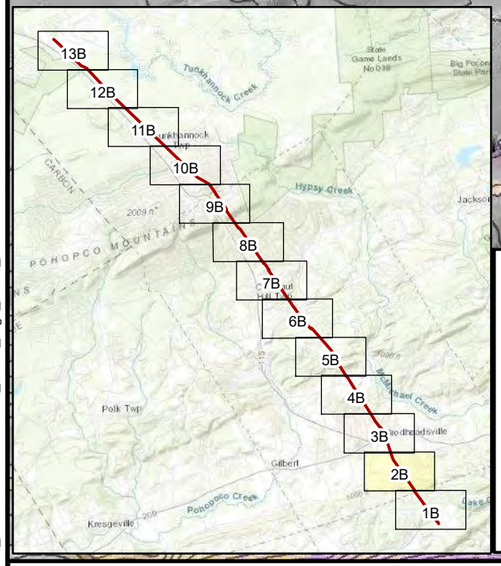
DATE:	10/12/2020	SCALE:	1 " = 500 '	PROJECT NO:	303-105		

NORTH

45.6
45.5
45.4
45.3
45.2
45.1
45
44.9
44.8
44.7

D
A
C

STEEP SLOPE RECONSTRUCTION
DETAIL 7



COMMONWEALTH OF PENNSYLVANIA
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ENGINEER
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SCALE IN FEET
0 500 1,000

LEGEND

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- SLOPES STEEPER THAN 2H:1V
- DEEP MINED AREA*
- PALUSTRINE EMERGENT
- PALUSTRINE FORESTED
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KEY NOTES

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B FURNISH AND INSTALL SLOPE TOE DRAIN OUTLET PER DETAIL 3, SHEET GT01

C FURNISH AND INSTALL WATERBAR TRENCH DRAIN OUTLET PER DETAIL 4, SHEET GT01

D FURNSIH AND INSTALL SIDE SLOPE TRENCH DRAIN PER DETAIL 5, SHEET GT01 AS NEEDED WITHIN TOPOGRAPHICAL AND PIPELINE TRENCH SAGS. OUTLET DRAIN LOCATIONS(S) TO BE DETERMINED IN THE FIELD DURING CONSTRUCTION

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4. PIPELINE ALIGNMENT, AND RELATED CONTENT PROVIDED BY WOOD GROUP SHARE POINT TITLED "Williams REA 242581"

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PENNSYLVANIA

EFFORT LOOP
GEOHAZARD ASSESSMENT

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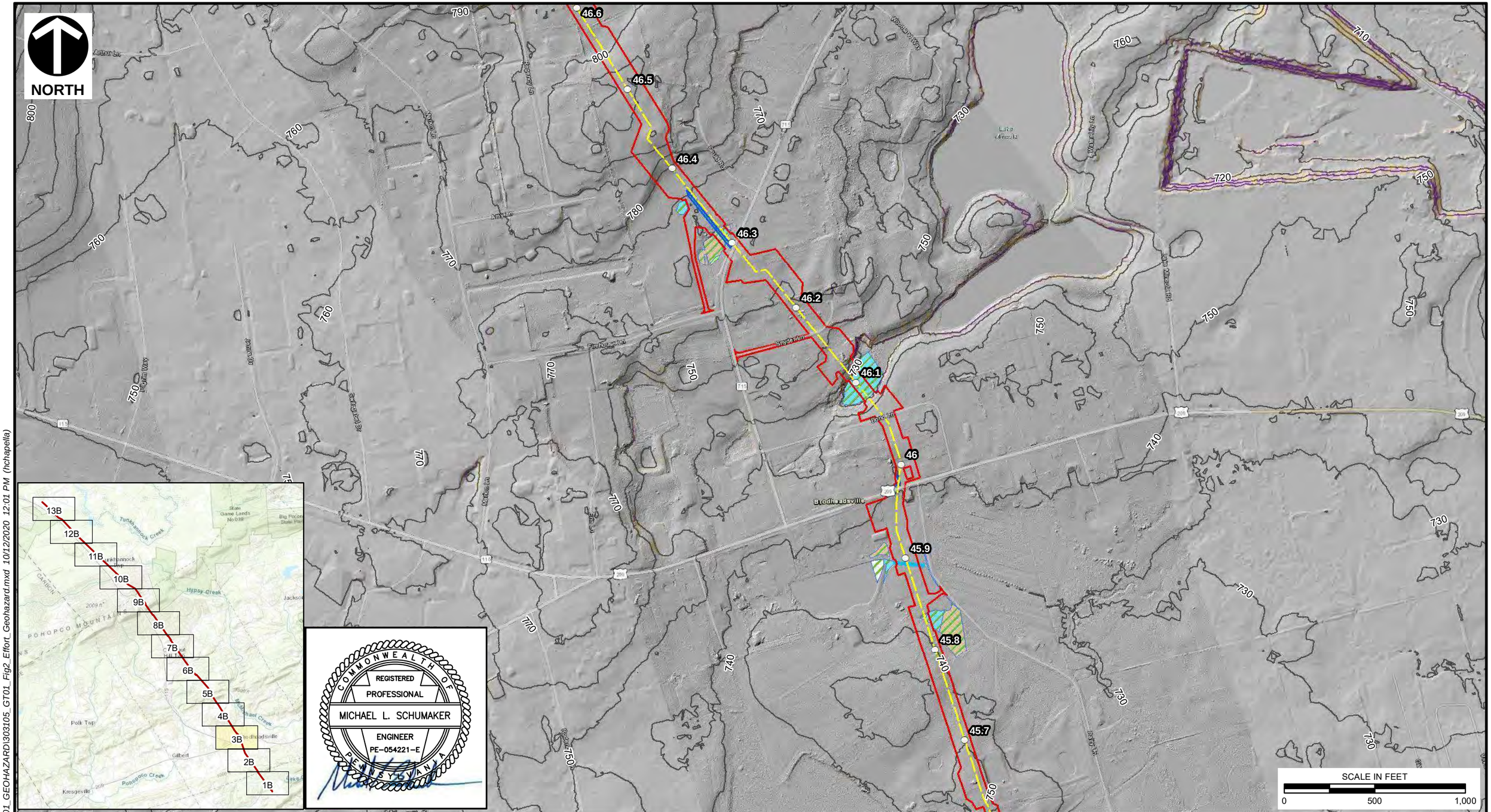

COMMONWEALTH OF PENNSYLVANIA
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MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

LEGEND

- MILE POST
- PROPOSED ALIGNMENT
- PERMANENT RIGHT-OF-WAY
- PROPOSED LIMIT-OF-DISTURBANCE
- EXISTING FACILITY
- COLLUVIAL SOIL
- GRAVEL PIT
- SLOPES 3H:1V - 2H:1V
- SLOPES STEEPER THAN 2H:1V
- DEEP MINED AREA*
- PALUSTRINE EMERGENT
- PALUSTRINE FORESTED
- PALUSTRINE SCRUB SHRUB
- STREAM
- INDEX CONTOUR - 10 FT
- PROPOSED DRAIN LOCATIONS

KEY NOTES

A. FURNISH AND INSTALL DRAINED TRENCH PLUG PER DETAIL 1, SHEET GT01

B. FURNISH AND INSTALL SLOPE TOE DRAIN OUTLET PER DETAIL 3, SHEET GT01

C. FURNISH AND INSTALL WATERBAR TRENCH DRAIN OUTLET PER DETAIL 4, SHEET GT01

D. FURNSIH AND INSTALL SIDE SLOPE TRENCH DRAIN PER DETAIL 5, SHEET GT01 AS NEEDED WITHIN TOPOGRAPHICAL AND PIPELINE TRENCH SAGS. OUTLET DRAIN LOCATIONS(S) TO BE DETERMINED IN THE FIELD DURING CONSTRUCTION

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FIGURE NO: **3B**

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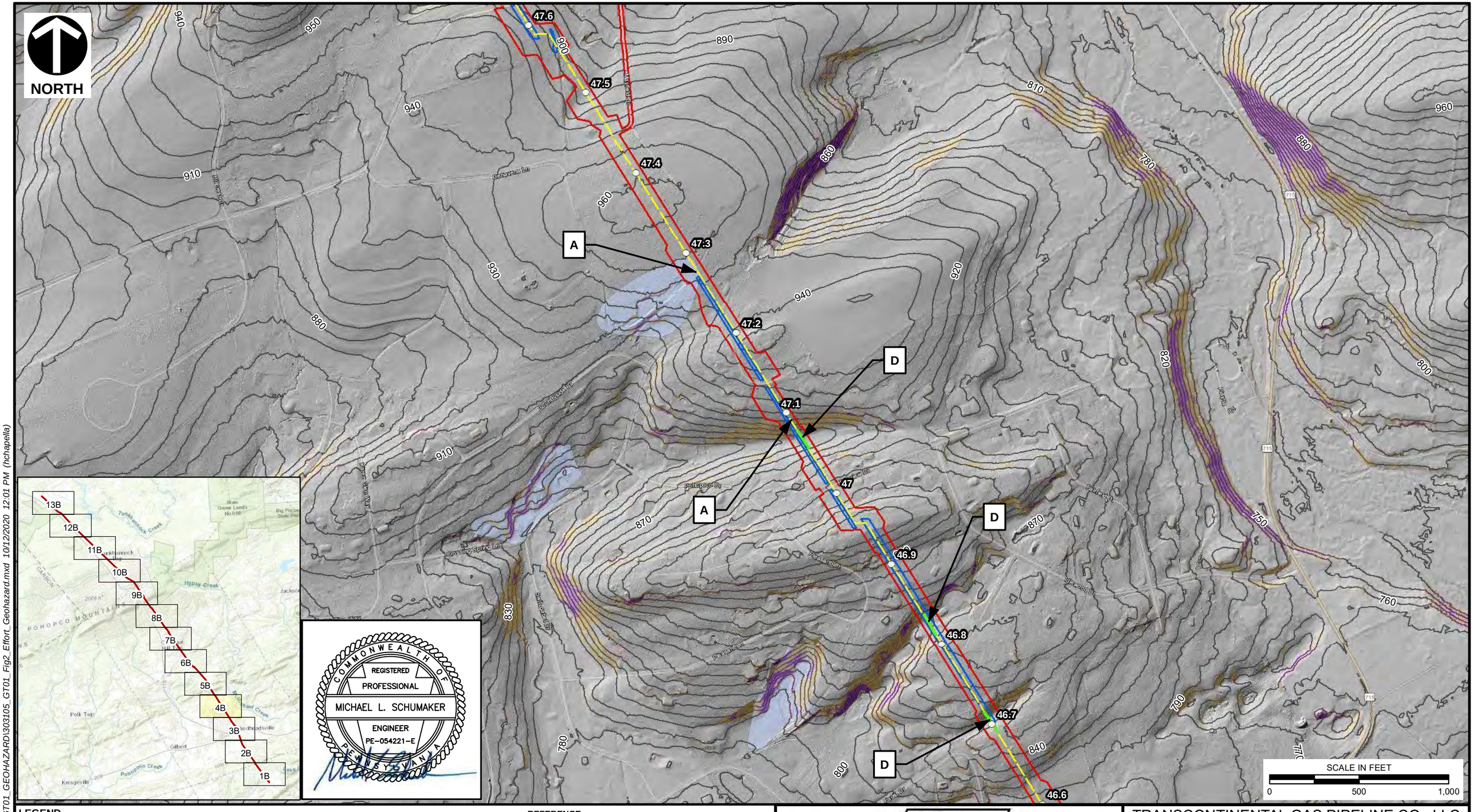

COMMONWEALTH OF PENNSYLVANIA
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MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

LEGEND

- MILE POST
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- EXISTING FACILITY
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- GRAVEL PIT
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- SLOPES STEEPER THAN 2H:1V
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- PALUSTRINE FORESTED
- PALUSTRINE SCRUB SHRUB
- STREAM
- INDEX CONTOUR - 10 FT
- PROPOSED DRAIN LOCATIONS

KEY NOTES

A FURNISH AND INSTALL DRAINED TRENCH PLUG PER DETAIL 1, SHEET GT01

B FURNISH AND INSTALL SLOPE TOE DRAIN OUTLET PER DETAIL 3, SHEET GT01

C FURNISH AND INSTALL WATERBAR TRENCH DRAIN OUTLET PER DETAIL 4, SHEET GT01

D FURNSIH AND INSTALL SIDE SLOPE TRENCH DRAIN PER DETAIL 5, SHEET GT01 AS NEEDED WITHIN TOPOGRAPHICAL AND PIPELINE TRENCH SAGS. OUTLET DRAIN LOCATIONS(S) TO BE DETERMINED IN THE FIELD DURING CONSTRUCTION

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FIGURE NO: **4B**

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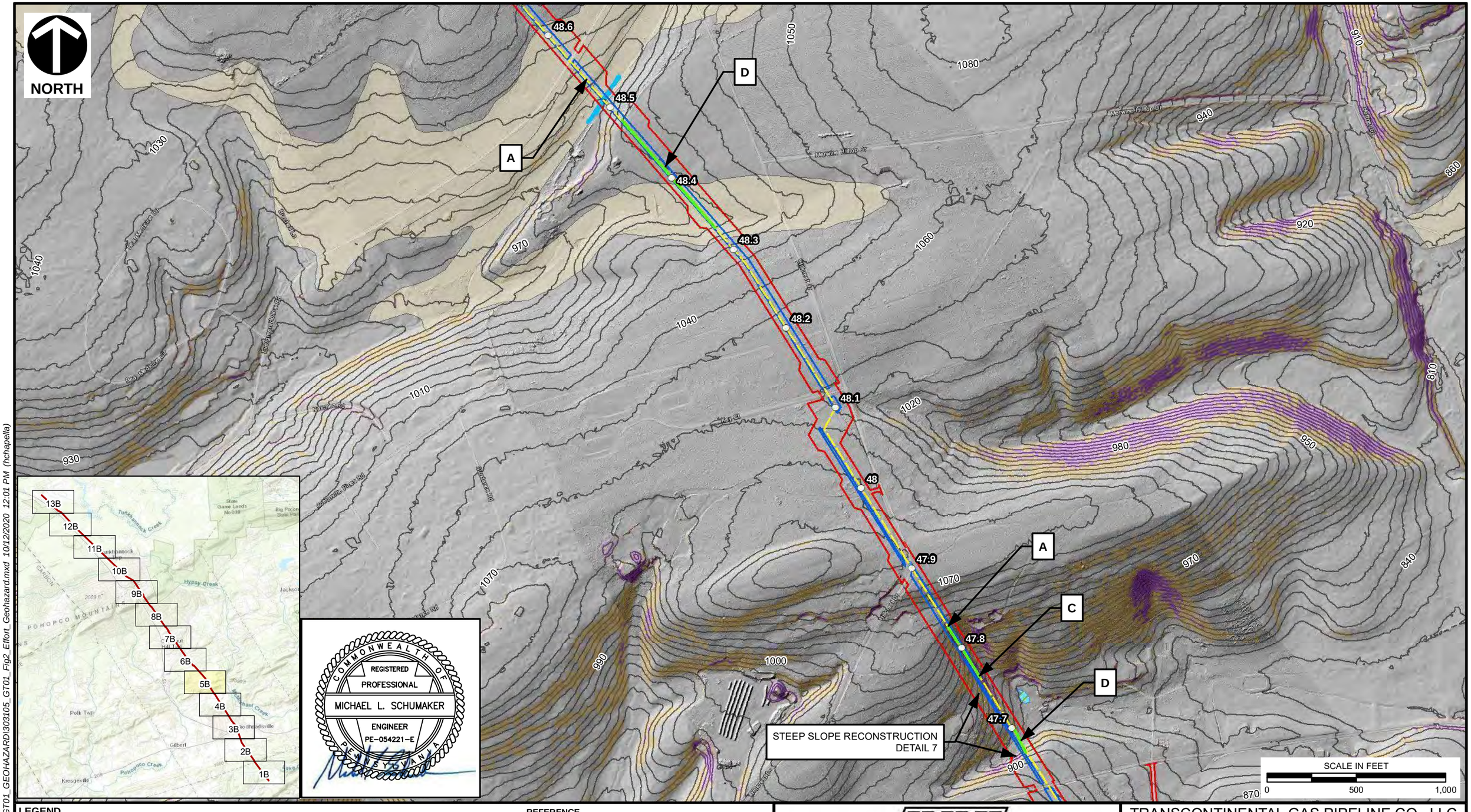

COMMONWEALTH OF PENNSYLVANIA
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MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

LEGEND

- MILE POST
- PROPOSED ALIGNMENT
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- STREAM
- INDEX CONTOUR - 10 FT
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KEY NOTES

A FURNISH AND INSTALL DRAINED TRENCH PLUG PER DETAIL 1, SHEET GT01

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C FURNISH AND INSTALL WATERBAR TRENCH DRAIN OUTLET PER DETAIL 4, SHEET GT01

D FURNSIH AND INSTALL SIDE SLOPE TRENCH DRAIN PER DETAIL 5, SHEET GT01 AS NEEDED WITHIN TOPOGRAPHICAL AND PIPELINE TRENCH SAGS. OUTLET DRAIN LOCATIONS(S) TO BE DETERMINED IN THE FIELD DURING CONSTRUCTION

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FIGURE NO: **5B**

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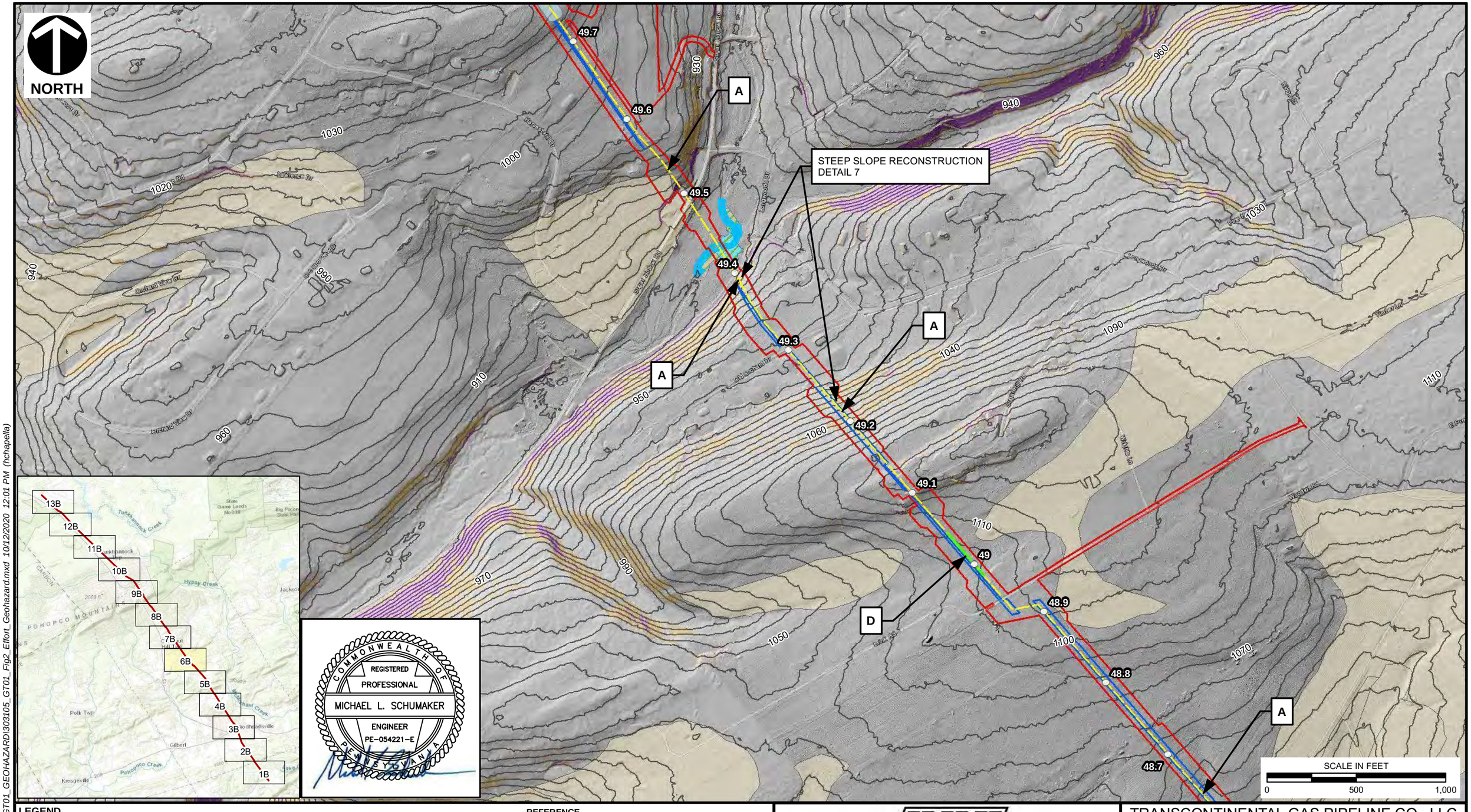

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ENGINEER
PE-054221-E

LEGEND

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KEY NOTES

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FIGURE NO: **6B**

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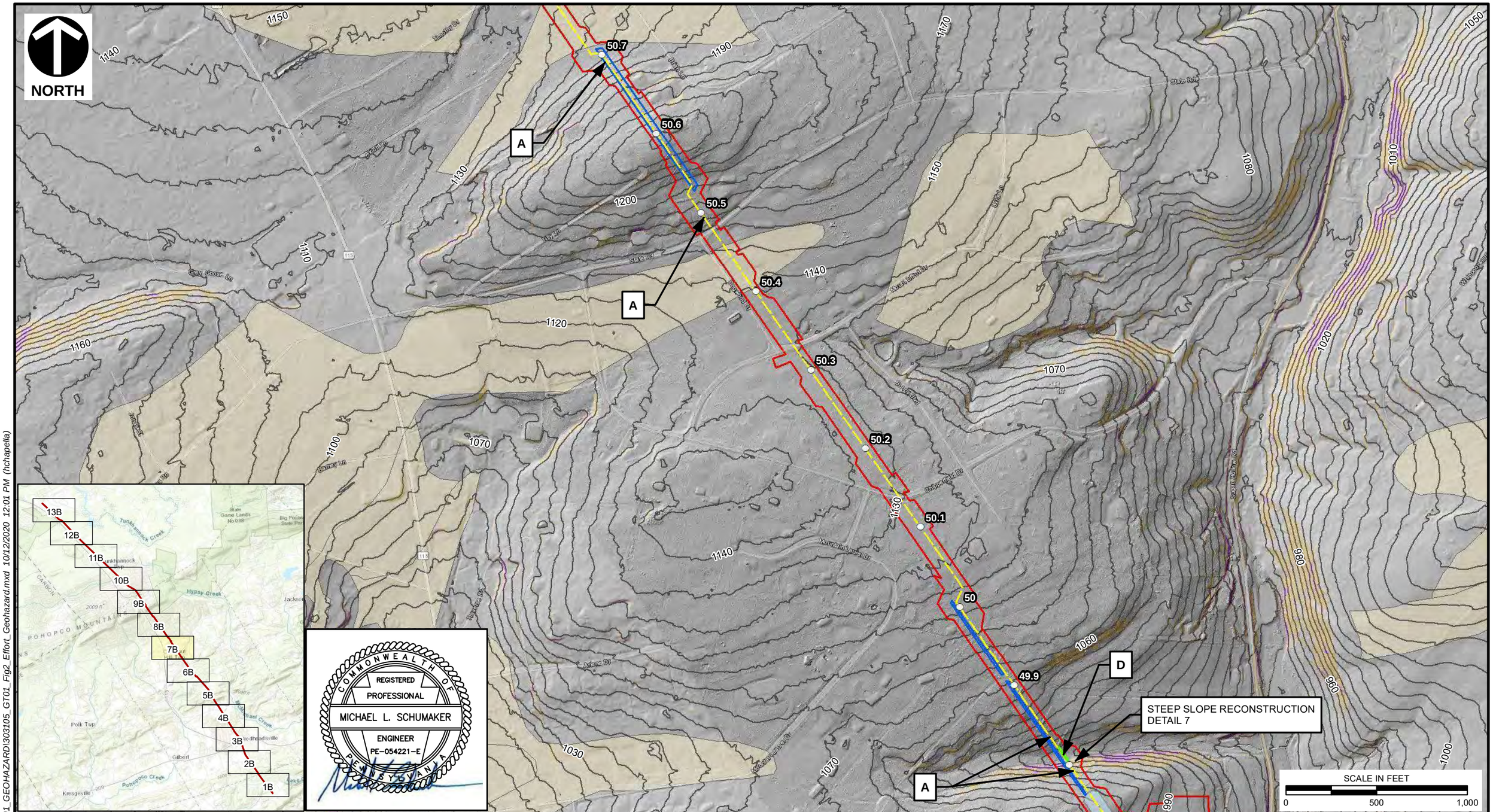

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ENGINEER
PE-054221-E

LEGEND

- MILE POST
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- STREAM
- INDEX CONTOUR - 10 FT
- PROPOSED DRAIN LOCATIONS

KEY NOTES

- A FURNISH AND INSTALL DRAINED TRENCH PLUG PER DETAIL 1, SHEET GT01
- B FURNISH AND INSTALL SLOPE TOE DRAIN OUTLET PER DETAIL 3, SHEET GT01
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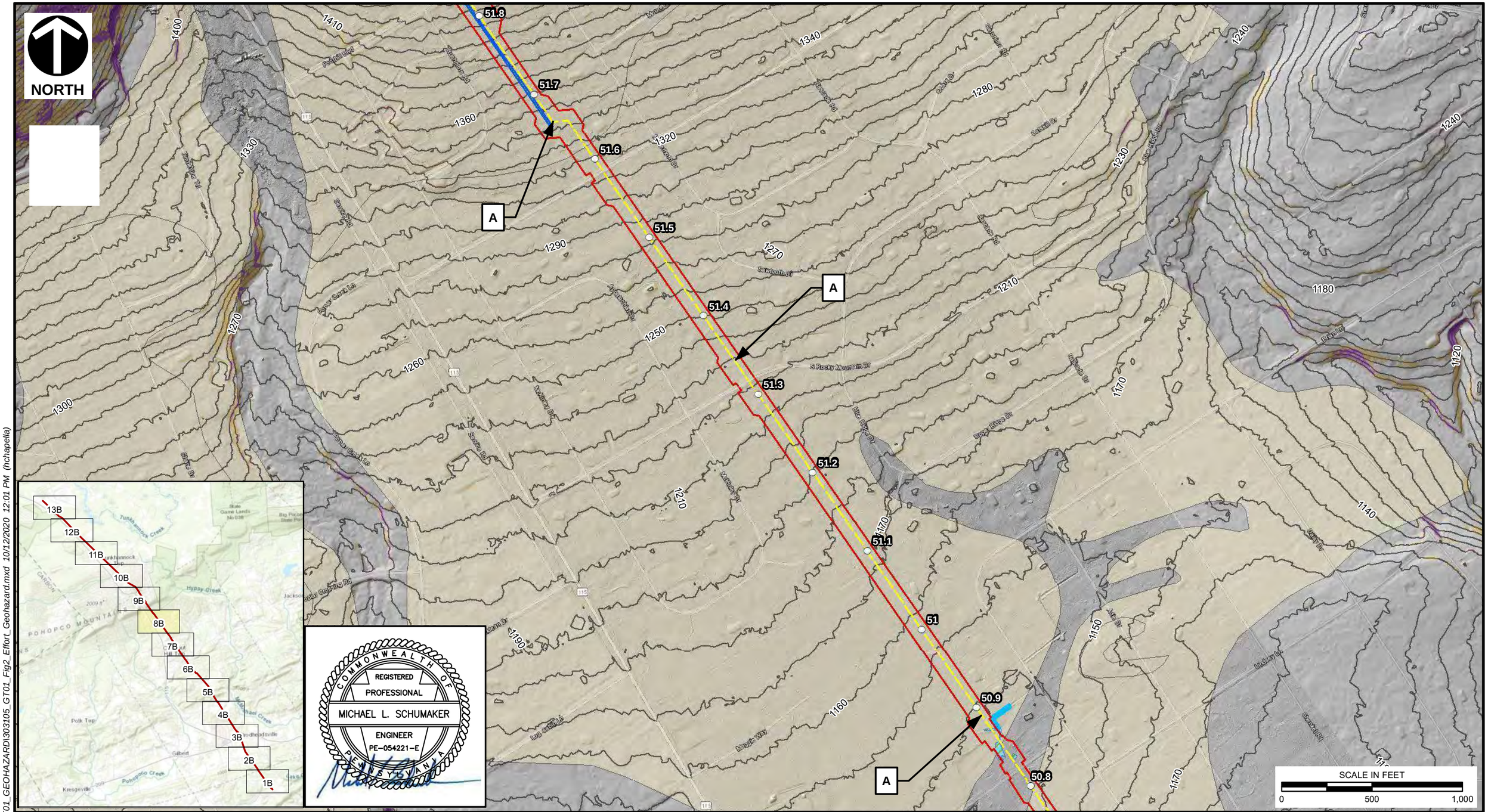

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LEGEND

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KEY NOTES

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FIGURE NO: **8B**

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NORTH

52.8
52.7
52.6
52.5
52.4
52.3
52.2
52.1
52
51.9

A
B
C
D

STEEP SLOPE RECONSTRUCTION
DETAIL 7

STEEP SLOPE RECONSTRUCTION
DETAIL 7

SCALE IN FEET
0 500 1,000

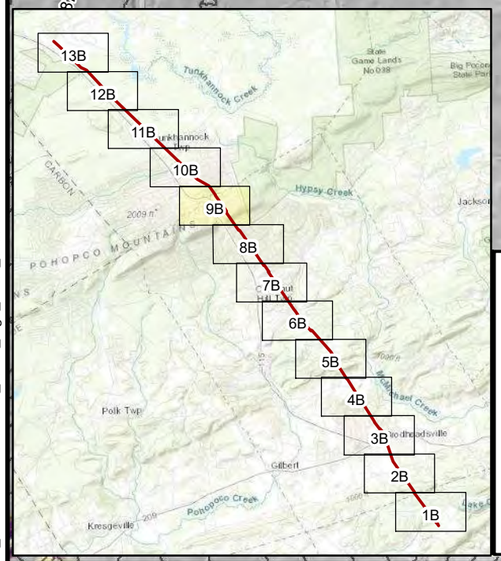

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FIGURE NO: **9B**

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NORTH

54.1
54
53.9
53.8
53.7
53.6
53.5
53.4
53.3
53.2
53.1
53
52.9

A

1890 1850 1870 1830 1840 1820 1860 1920 1810 1880 1900 1790

13B 12B 11B 10B 9B 8B 7B 6B 5B 4B 3B 2B 1B

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MICHAEL L. SCHUMAKER
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PE-054221-E

SCALE IN FEET
0 500 1,000

LEGEND

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REFERENCE

1. RADBRUCH-HALL & OTHERS, 1976, LANDSLIDE OVERVIEW OF THE CONTERMINOUS UNITED STATES, U.S. GEOLOGICAL SURVEY, MAP MF-771
2. U.S.D.A. SOIL SURVEY GEOGRAPHIC (SSURGO) DATABASE FOR MONROE COUNTY, PENNSYLVANIA, 2015
3. TOPOGRAPHY GENERATED FROM PAMAP PROGRAM 2008 DIGITAL ELEVATION MODEL OF PENNSYLVANIA; DEVELOPED BY PA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES AND ENHANCED WITH TOPOGRAPHY GENERATED FROM UNMANNED AERIAL SYSTEM (UAS) RECORDED DATA COLLECTED FOR WILLIAMS IN 2019.
4. PIPELINE ALIGNMENT, AND RELATED CONTENT PROVIDED BY WOOD GROUP SHARE POINT TITLED "Williams REA 242581"

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REGIONAL ENERGY ACCESS PIPELINE
LUZERNE AND MONROE COUNTIES
PENNSYLVANIA

EFFORT LOOP
GEOHAZARD ASSESSMENT

DRAWN BY:	HCC	CHECKED BY:	KID	APPROVED BY: * Hand signature on file MLS*	FIGURE NO: 10B
DATE:	10/12/2020	SCALE:	1 " = 500 '	PROJECT NO: 303-105	

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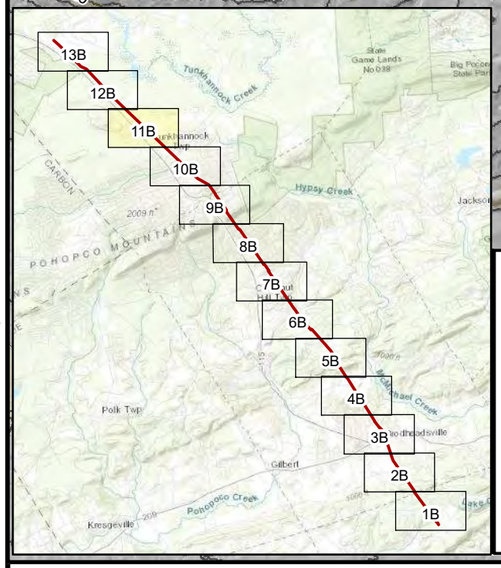

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

SCALE IN FEET
0 500 1,000

LEGEND

- MILE POST
- PROPOSED ALIGNMENT
- PERMANENT RIGHT-OF-WAY
- PROPOSED LIMIT-OF-DISTURBANCE
- EXISTING FACILITY
- COLLUVIAL SOIL
- GRAVEL PIT
- SLOPES 3H:1V - 2H:1V
- SLOPES STEEPER THAN 2H:1V
- DEEP MINED AREA*
- PALUSTRINE EMERGENT
- PALUSTRINE FORESTED
- PALUSTRINE SCRUB SHRUB
- STREAM
- INDEX CONTOUR - 10 FT
- PROPOSED DRAIN LOCATIONS

KEY NOTES

A FURNISH AND INSTALL DRAINED TRENCH PLUG PER DETAIL 1, SHEET GT01

B FURNISH AND INSTALL SLOPE TOE DRAIN OUTLET PER DETAIL 3, SHEET GT01

C FURNISH AND INSTALL WATERBAR TRENCH DRAIN OUTLET PER DETAIL 4, SHEET GT01

D FURNSIH AND INSTALL SIDE SLOPE TRENCH DRAIN PER DETAIL 5, SHEET GT01 AS NEEDED WITHIN TOPOGRAPHICAL AND PIPELINE TRENCH SAGS. OUTLET DRAIN LOCATIONS(S) TO BE DETERMINED IN THE FIELD DURING CONSTRUCTION

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DATE:	10/12/2020	SCALE:	1 " = 500 '	PROJECT NO:	303-105

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PENNSYLVANIA

EFFORT LOOP
GEOHAZARD ASSESSMENT

FIGURE NO: **11B**

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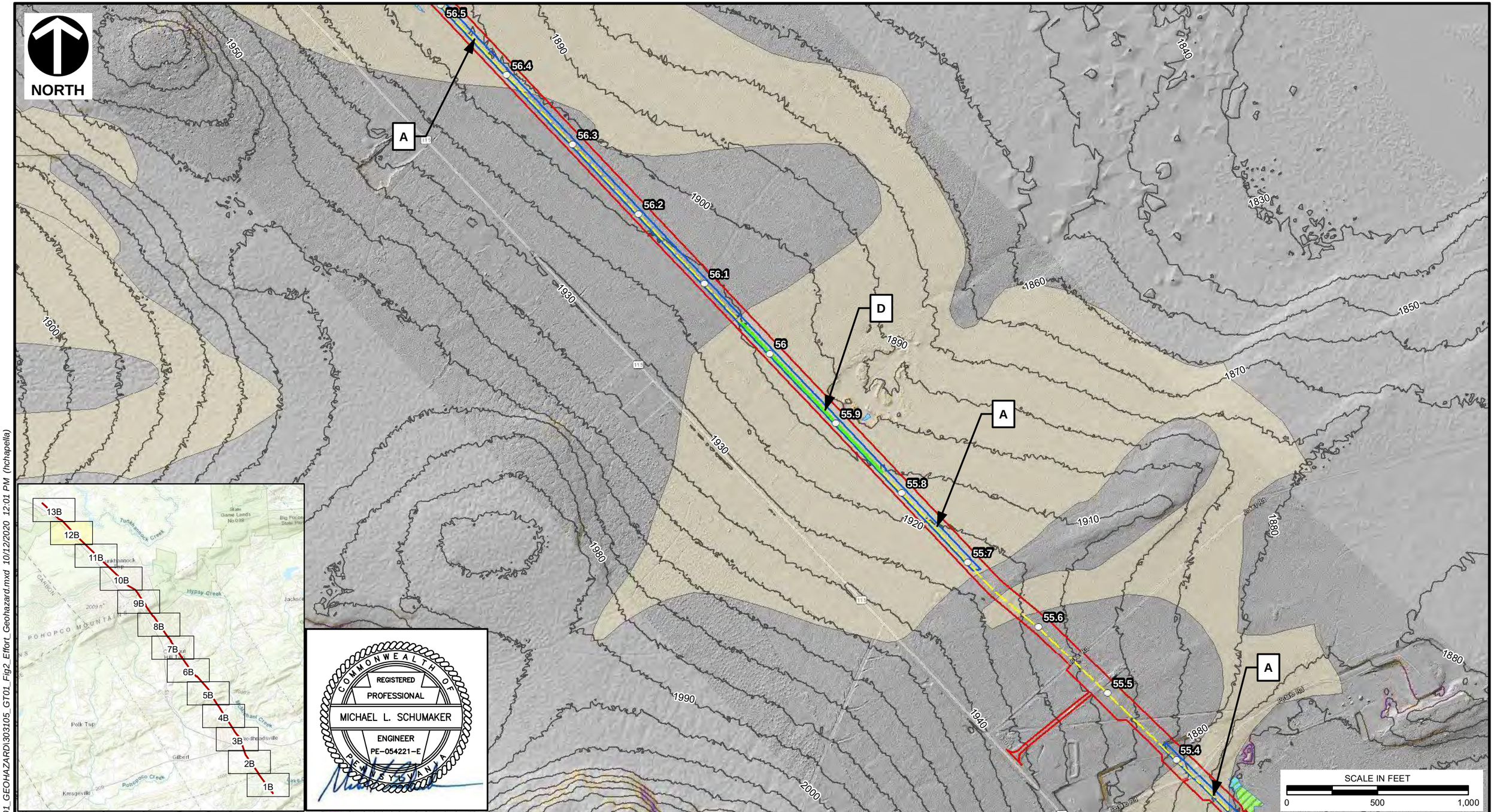

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MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

LEGEND

- MILE POST
- PROPOSED ALIGNMENT
- PERMANENT RIGHT-OF-WAY
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KEY NOTES

- A FURNISH AND INSTALL DRAINED TRENCH PLUG PER DETAIL 1, SHEET GT01
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EFFORT LOOP
GEOHAZARD ASSESSMENT

DRAWN BY:	HCC	CHECKED BY:	KID	APPROVED BY: * Hand signature on file MLS*	FIGURE NO: 12B
DATE:	10/12/2020	SCALE:	1 " = 500 '	PROJECT NO:	303-105

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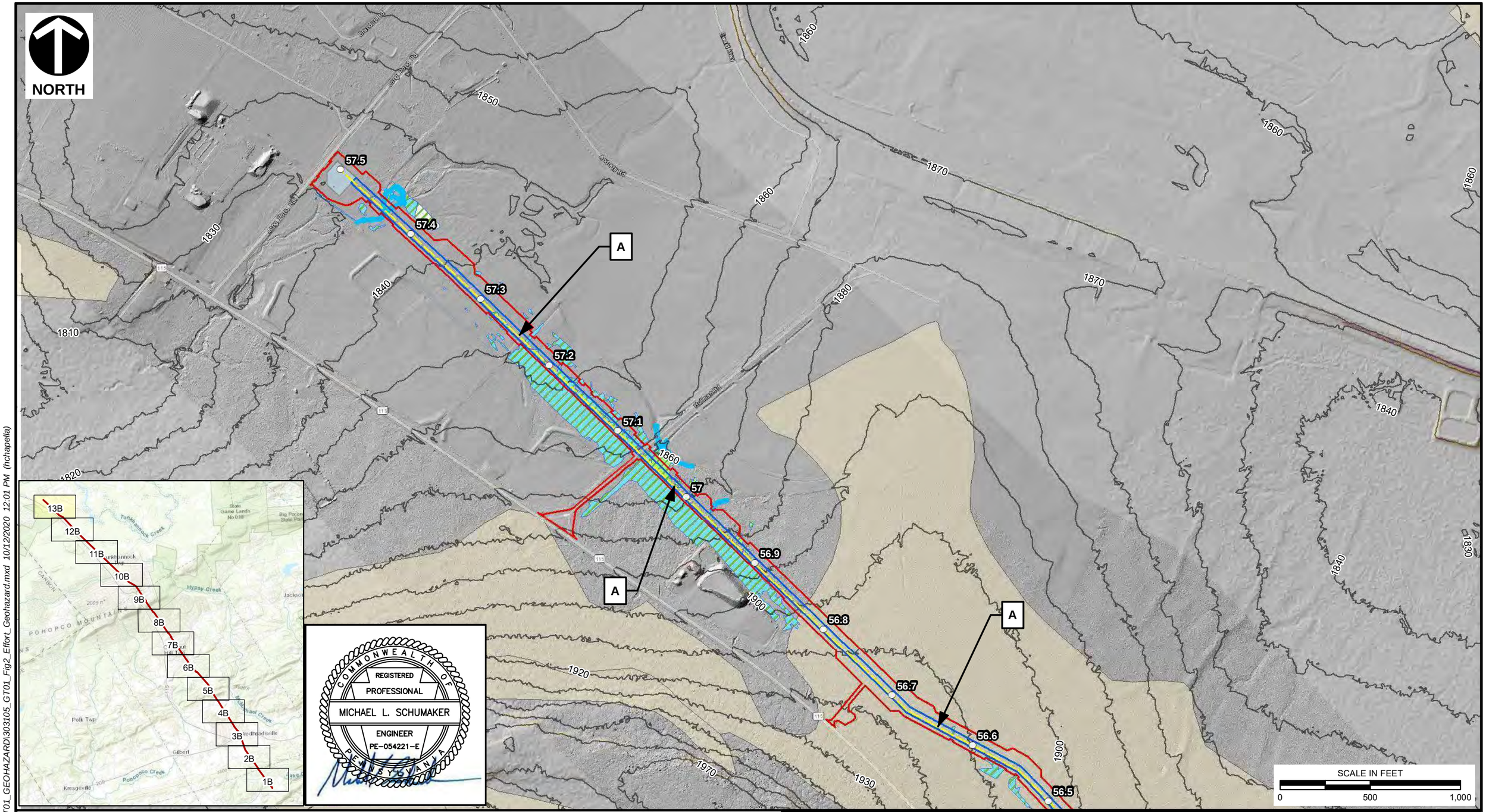

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MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

LEGEND

- MILE POST
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GEOHAZARD ASSESSMENT

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DATE:	10/12/2020	SCALE:	1 " = 500 '	PROJECT NO:	303-105

FIGURE NO: **13B**

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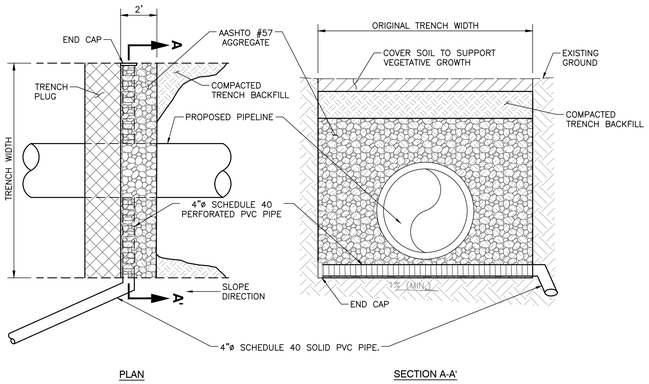
APPENDIX C

GEOHAZARD MITIGATION DETAILS

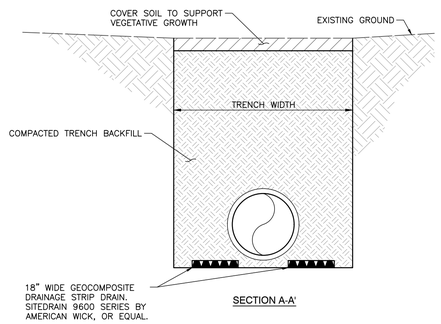


PLAN SECTION A-A'

NOTE:

1. DAYLIGHT DISCHARGE PIPE TO RIPRAP EMBEDMENT TERMINUS (SEE DETAIL 9).
2. SLOPE BASE OF PIPE TRENCH, AT THE UPSLOPE SIDE OF TRENCH PLUG TOWARDS THE OUTLET PIPE AT A MINIMUM 1% GRADE.

DETAIL 1
DRAINED TRENCH PLUG
NOT TO SCALE

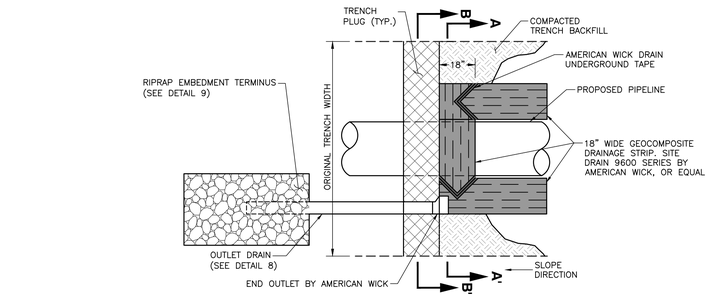


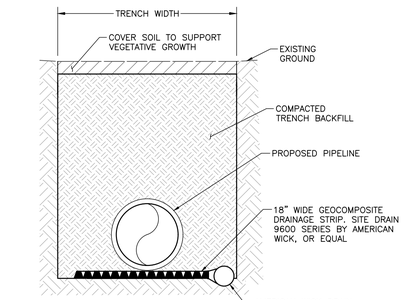
SECTION A-A'

NOTES:

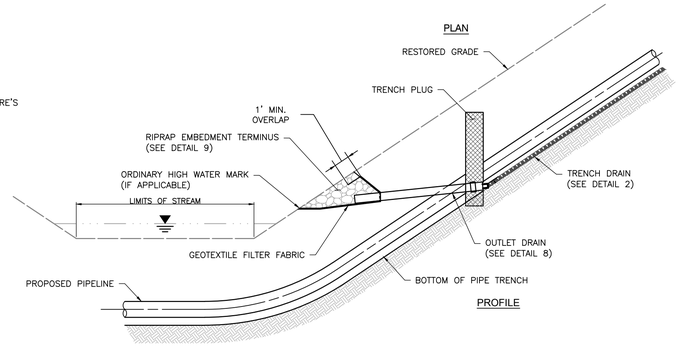
1. SPLICE GEOCOMPOSITE DRAINAGE STRIPS IN ACCORDANCE WITH THE MANUFACTURE'S RECOMMENDATIONS.
2. PLACE GEOCOMPOSITE DRAINAGE STRIPS AT THE BOTTOM OF THE PIPE TRENCH PRIOR TO BACKFILLING. DO NOT CRUSH DRAIN WITH CRIBBING.

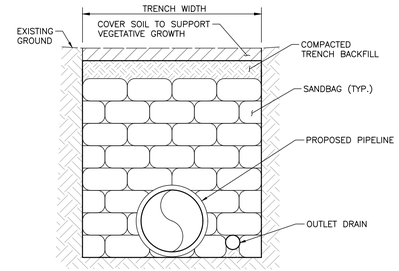
DETAIL 2
TRENCH DRAIN
NOT TO SCALE





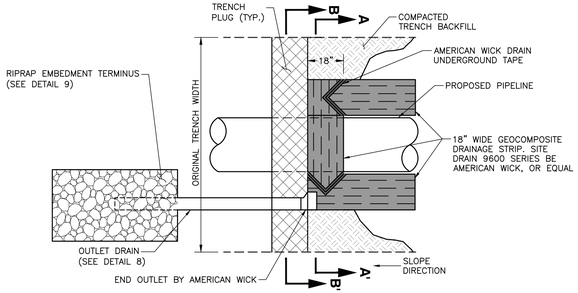
SECTION A-A'

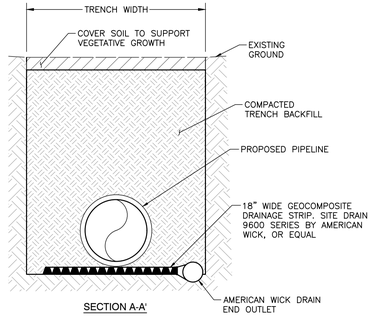




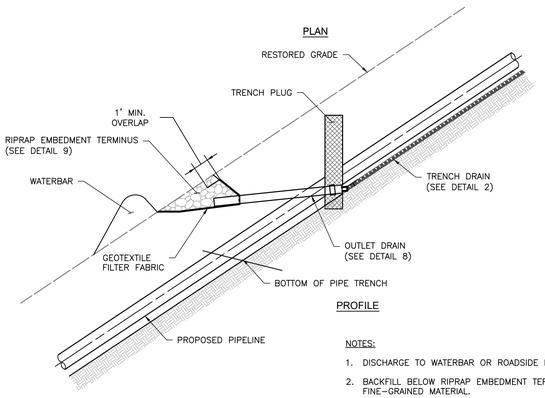
SECTION B-B'

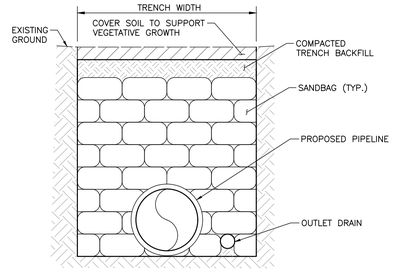
DETAIL 3
SLOPE TOE TRENCH DRAIN OUTLET
NOT TO SCALE





SECTION A-A'





SECTION B-B'

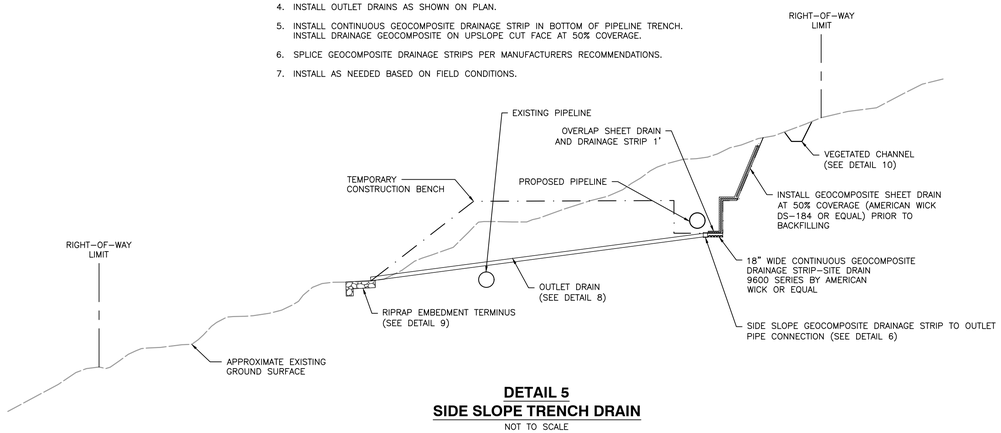
NOTES:

1. DISCHARGE TO WATERBAR OR ROADSIDE DITCH.
2. BACKFILL BELOW RIPRAP EMBEDMENT TERMINUS WITH CLAY OR OTHER FINE-GRAINED MATERIAL.

DETAIL 4
WATERBAR TRENCH DRAIN OUTLET
NOT TO SCALE

SIDE SLOPE DETAIL NOTES

1. INSTALL TOP OF PIPELINE AT 8' BELOW THE EXISTING GROUND SURFACE. EVALUATE ACTUAL LANDSLIDE/COLLUVIUM DEPTH PRIOR TO TRENCHING BY EXCAVATING TEST PITS UNDER THE DIRECTION OF A CEC GEOTECHNICAL REPRESENTATIVE. CONSIDER DEEPENING/SHALLOWING PIPELINE BASED ON FINDINGS.
2. MONITOR AREAS UPSLOPE AND DOWNSLOPE FROM TRENCH FOR MOVEMENT DURING PIPELINE TRENCHING AND INSTALLATION.
3. SLOPE TEMPORARY EXCAVATION AWAY FROM PIPELINE TRENCH.
4. INSTALL OUTLET DRAINS AS SHOWN ON PLAN.
5. INSTALL CONTINUOUS GEOCOMPOSITE DRAINAGE STRIP IN BOTTOM OF PIPELINE TRENCH. INSTALL DRAINAGE GEOCOMPOSITE ON UPSLOPE CUT FACE AT 50% COVERAGE.
6. SPLICE GEOCOMPOSITE DRAINAGE STRIPS PER MANUFACTURERS RECOMMENDATIONS.
7. INSTALL AS NEEDED BASED ON FIELD CONDITIONS.



DETAIL 5
SIDE SLOPE TRENCH DRAIN
NOT TO SCALE

REVISION RECORD

NO	DATE	DESCRIPTION

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TRANSCONTINENTAL GAS PIPELINE COMPANY, LLC.
REGIONAL ENERGY ACCESS PROJECT
LUZERNE AND MONROE COUNTIES
PENNSYLVANIA

LANDSLIDE MITIGATION DETAILS

DATE:	AUGUST 2020
DWG SCALE:	AS NOTED
PROJECT NO:	303-105
DRAWN BY:	JAH
CHECKED BY:	KID
APPROVED BY:	MLS

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

DRAWING NO.:
GT01

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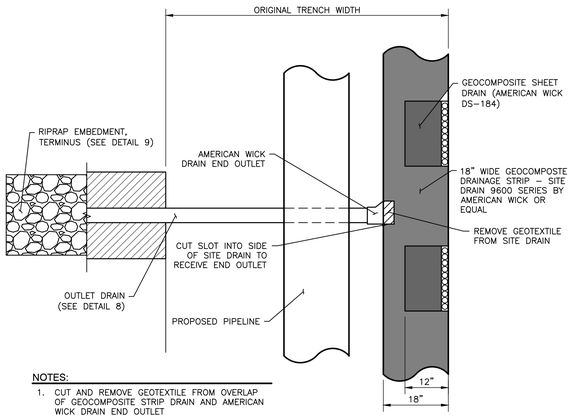
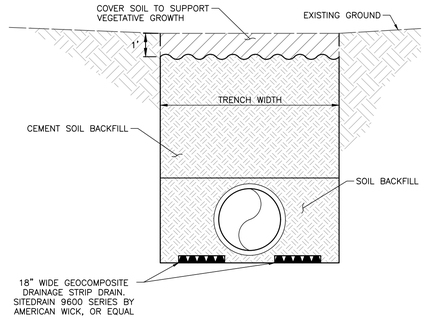


NOTES:

1. CUT AND REMOVE GEOTEXTILE FROM OVERLAP OF GEOCOMPOSITE STRIP DRAIN AND AMERICAN WICK DRAIN END OUTLET

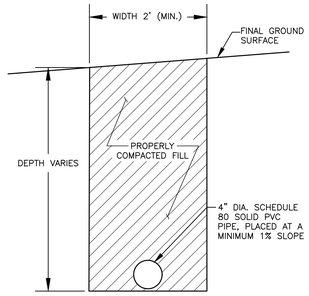
DETAIL 6
SIDE SLOPE GEOCOMPOSITE DRAINAGE STRIP TO OUTLET PIPE CONNECTION
NOT TO SCALE



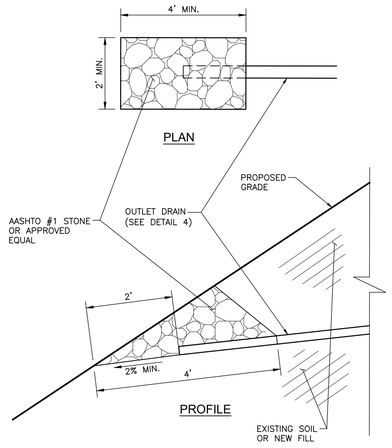
NOTES:

1. CEMENT SOIL BACKFILL SHALL BE THOROUGHLY MIXED WITH 8% CEMENT. BREAK ALL CLUMPS AND CLODS DURING MIXING. ADD WATER DURING MIXING AS NECESSARY TO PROPERLY HYDRATE.
2. LEAVE SURFACE OF BACKFILL ROUGHENED AND COVER WITH 1 FOOT OF SOIL FOR VEGETATION.

DETAIL 7
PIPELINE TRENCH CEMENT SOIL BACKFILL
NOT TO SCALE



DETAIL 8
OUTLET DRAIN
NOT TO SCALE



DETAIL 9
RIPRAP EMBEDMENT TERMINUS
NOT TO SCALE

REVISION RECORD

NO	DATE	DESCRIPTION

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TRANSCONTINENTAL GAS PIPELINE COMPANY, LLC.
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LUZERNE AND MONROE COUNTIES
PENNSYLVANIA

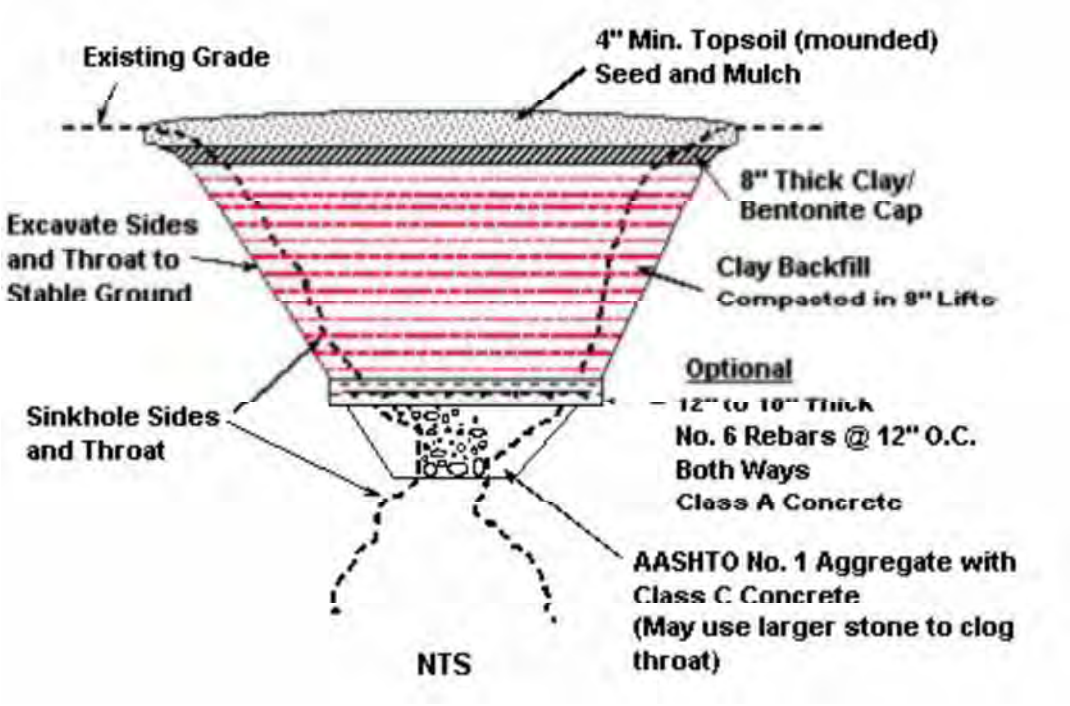
LANDSLIDE MITIGATION DETAILS

DATE:	AUGUST 2020	DRAWN BY:	JAH
DWG SCALE:	AS NOTED	CHECKED BY:	KID
PROJECT NO:			303-105
APPROVED BY:			MLS

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

DRAWING NO.:
GT02

PADEP Sinkhole Repair with Bentonite Cap Detail



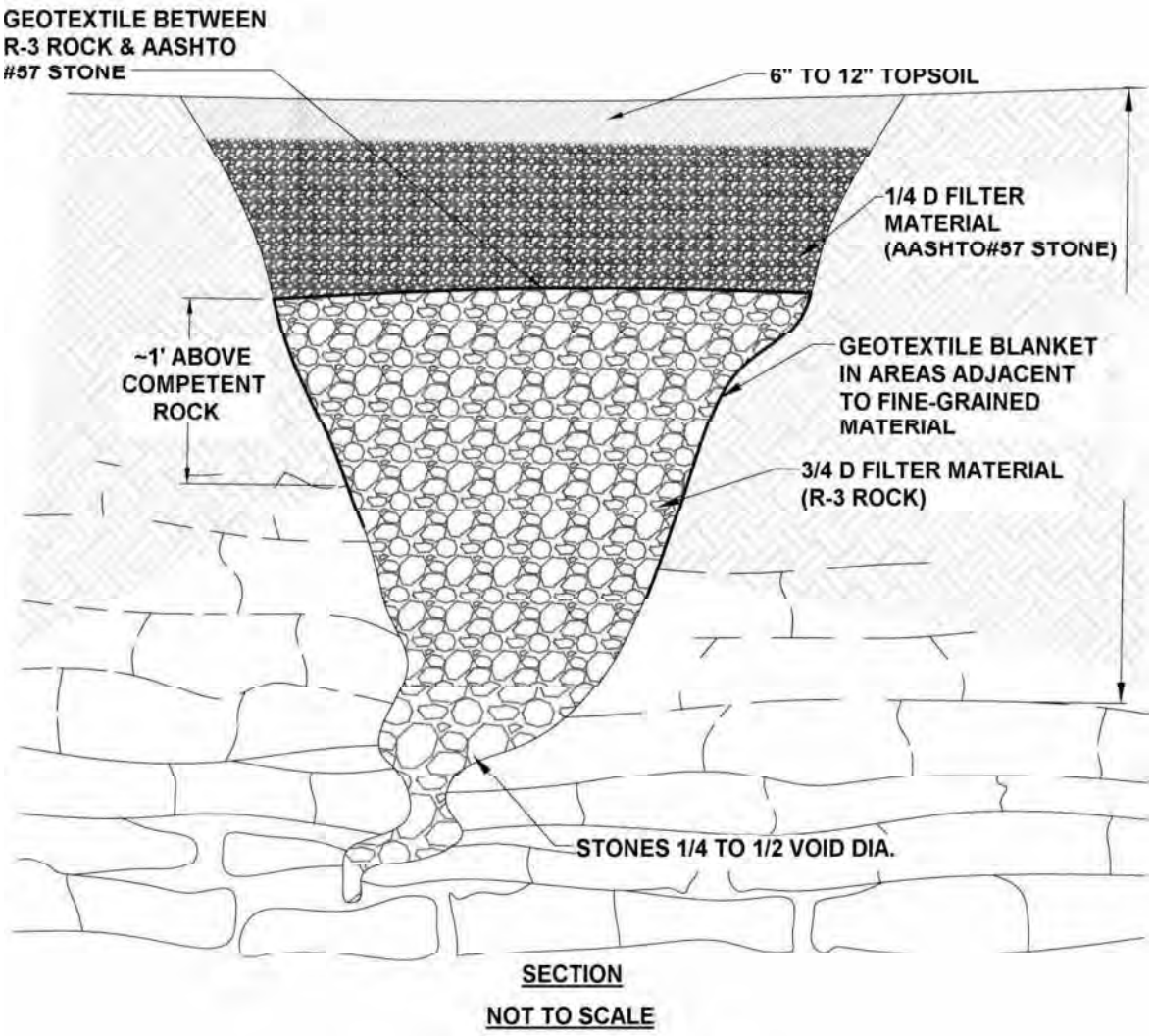
Source: Adapted from PADEP

Notes:

1. Loose material shall be excavated from the sinkhole and expose solution void(s) if possible. Enlarge sinkhole if necessary to allow for installation of filter materials. Occupational Safety and Health Administration (OSHA) regulations must be followed at all times during excavation.

2. Stones used for the “bridge” and filters shall have a moderately hard rock strength and be resistant to abrasion and degradation. Shale and similar soft and/or non-durable rock are not acceptable.

USDA NRCS Sinkhole Repair with Pervious Cover Detail



Source: Adapted from USDA NRCS

Notes

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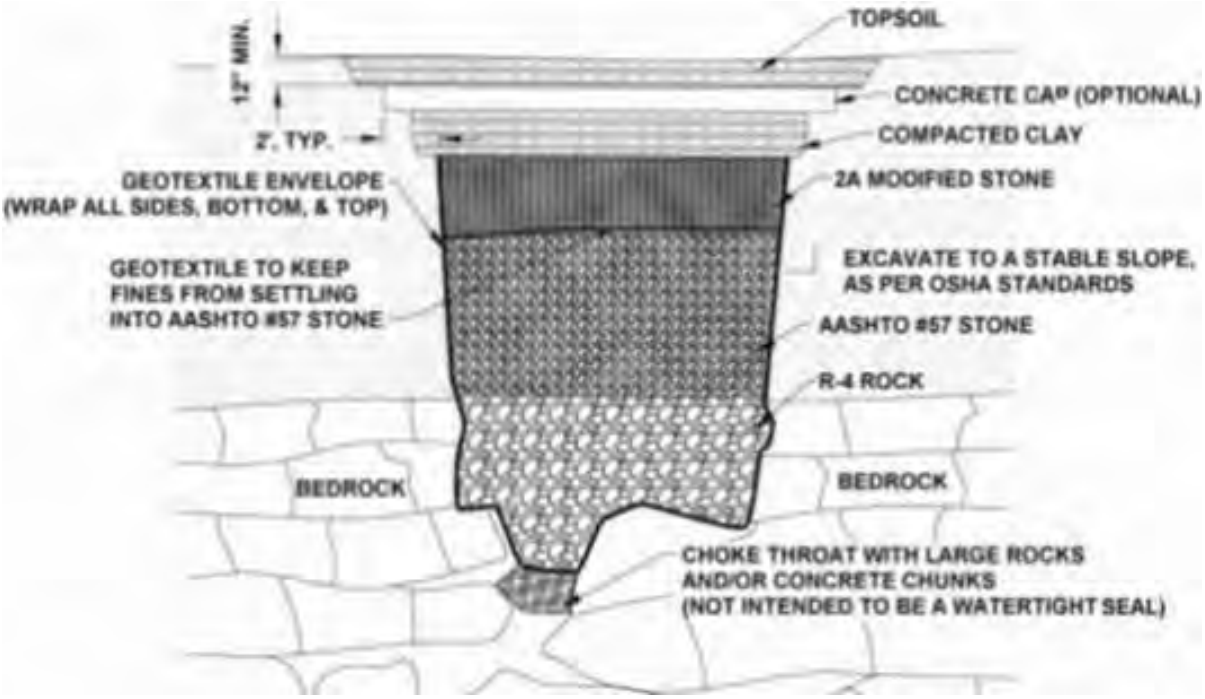
2. Stones used for the "bridge" and filters shall have a moderately hard rock strength and be resistant to abrasion and degradation. Shale and similar soft and/or non-durable rock are not acceptable.

USDA NRCS Sinkhole Repair with Impervious Cover Detail



Source: Adapted from USDA NRCS

Notes:

1. Loose material shall be excavated from the sinkhole and expose solution void(s) if possible. Enlarge sinkhole if necessary to allow for installation of filter materials. OSHA regulations must be followed at all times during excavation.

2. Geotextile shall be non-woven with a burst strength between 100 and 200 psi.

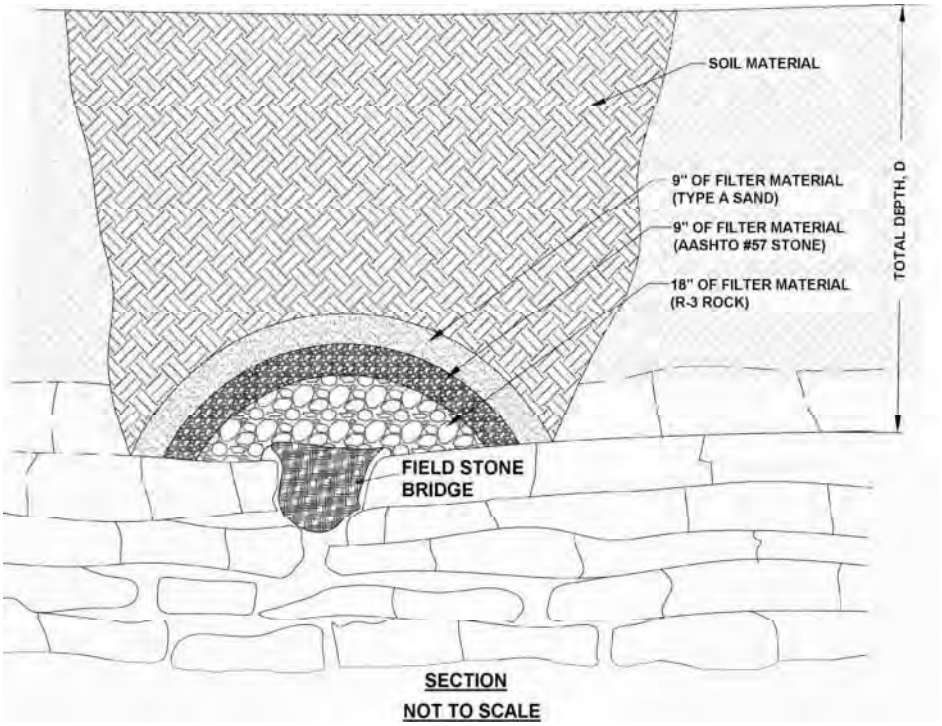
3. Select field stone(s) about 1.5 times larger than solution void(s) to form “bridge.” Place rock(s) so no large openings exist along the sides. Stones used for the “bridge” and filters shall have a moderately hard rock strength and be resistant to abrasion and degradation. Shale and similar soft and/or non-durable rock are not acceptable.

4. Minimum thickness of R-4 rock is 18.” AASHTO #57 stone thickness shall be ¼ to ½ that of the R-4 rock. Minimum thickness of 2A modified crushed stone shall be 9” AASHTO #57 stone and 2A modified crushed stone shall be compacted after each placement.

5. Compacted clay seal shall be a minimum of 12” thick. Clay shall be placed in 6” to 9” lifts and thoroughly compacted. Concrete cap, which is optional, shall be a minimum of 8” thick. Use 4,000 psi concrete with 6” X 6” - 6 gauge welded wire fabric, or # 3 rebar on 18” O.C. both ways.

6. Topsoil shall be a minimum of 12” thick. Grade for drainage away from sinkhole area.

USDA NRCS Sinkhole Repair with Soil Cover Detail



Source: Adapted from USDA NRCS

Notes:

1. Loose material shall be excavated from the sinkhole and expose solution void(s) if possible. Enlarge sinkhole if necessary to allow for installation of filter materials. OSHA regulations must be followed at all times during excavation.

2. Select field stone(s) about 1.5 times larger than solution void(s) to form “bridge.” Place rock(s) so no large openings exist along the sides. Stones used for the “bridge” and filters shall have a moderately hard rock strength and be resistant to abrasion and degradation. Shale and similar soft and/or non-durable rock are not acceptable.

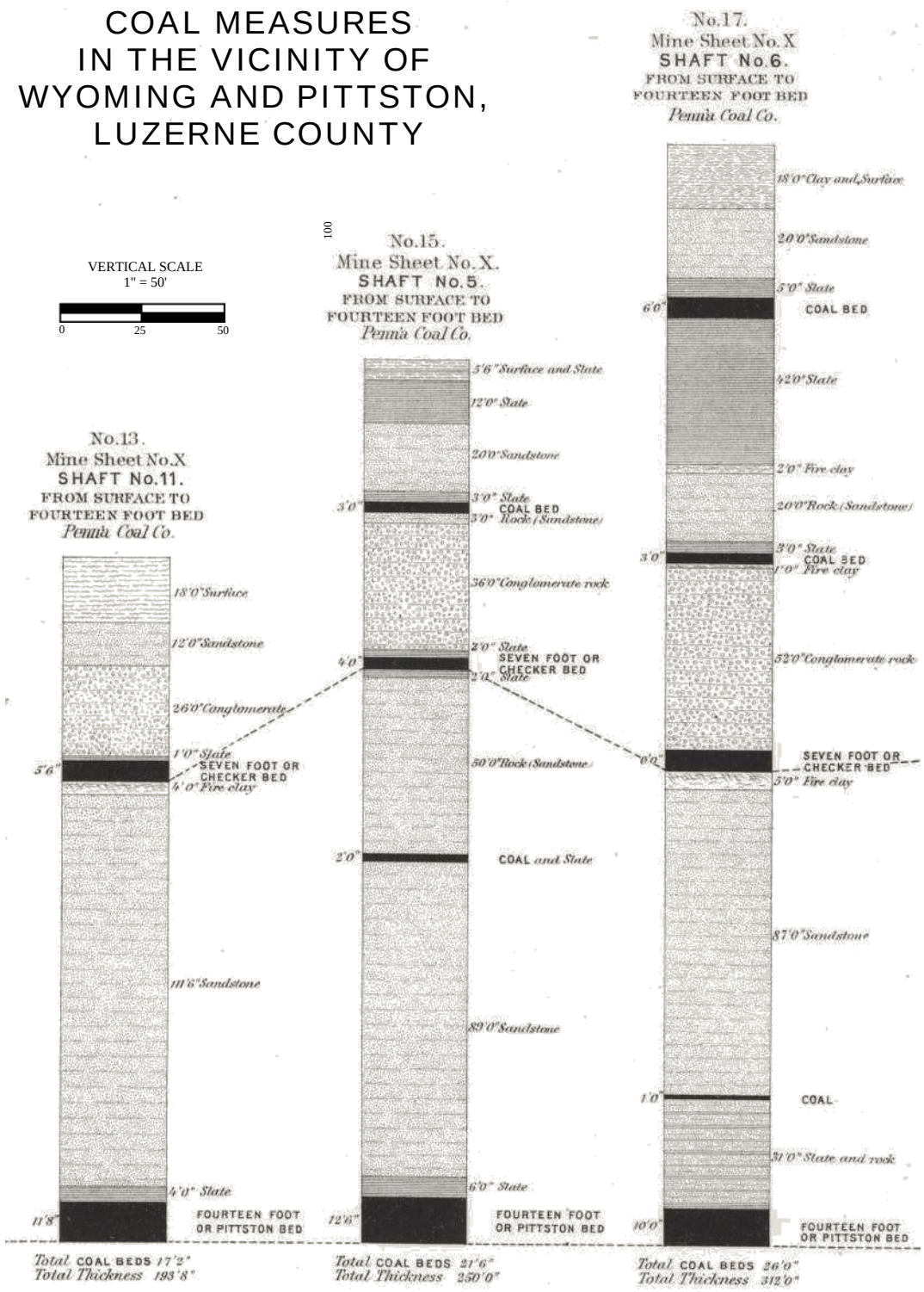
3. Minimum thickness of R-3 rock is 18” AASHTO #57 stone thickness shall be a minimum of 9” thick. Minimum thickness of type A sand shall be 9”. NOTE: A non-woven geotextile with a burst strength between 100 and 200 psi may be substituted for the AASHTO#57 stone and type A sand.

4. Soil shall be mineral soil with at least 12% fines and overfilled by 5% to allow for settlement. Suitable soil from the excavation may be used. Any available topsoil shall be placed on top surface.

APPENDIX D

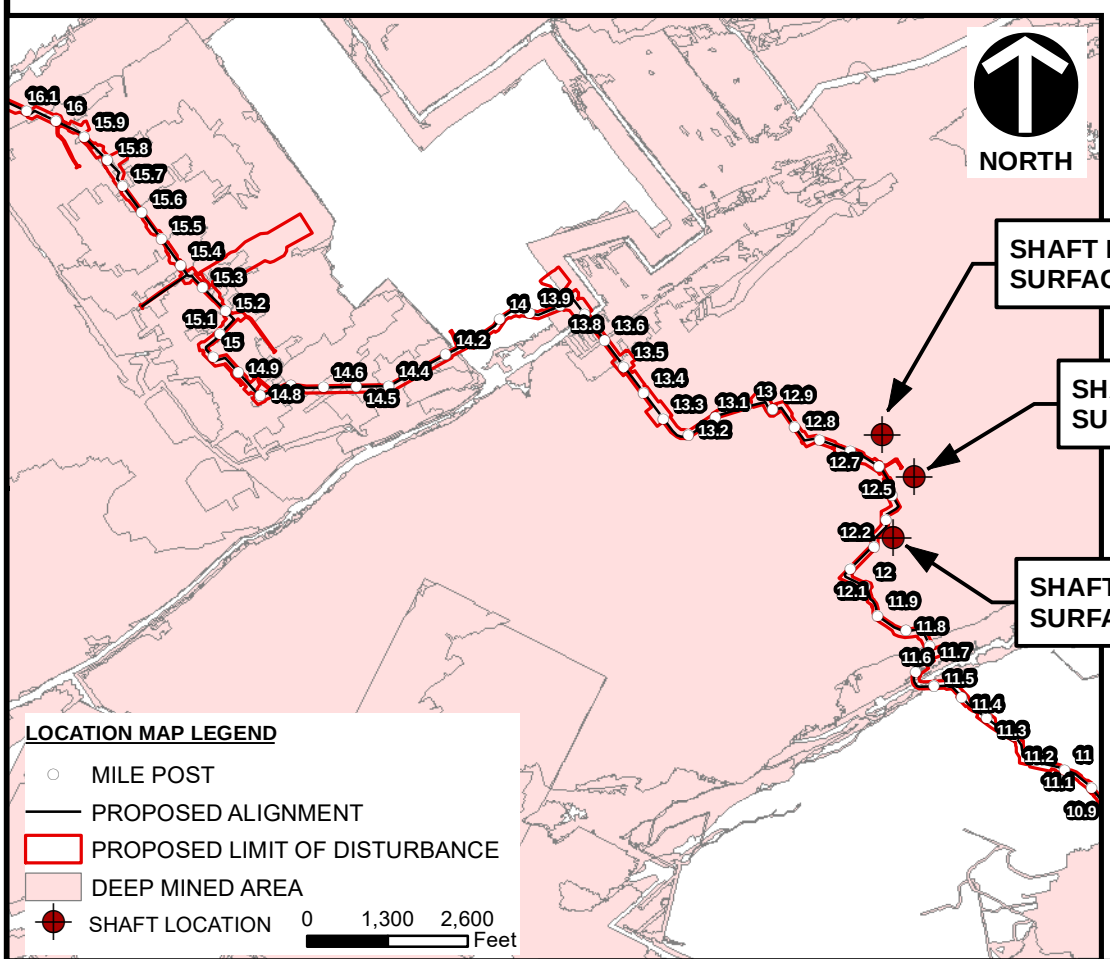
STRATIGRAPHIC COLUMNS

EXCERPT FROM: COLUMNAR SECTIONS OF THE COAL MEASURES IN THE VICINITY OF WYOMING AND PITTSTON, LUZERNE COUNTY

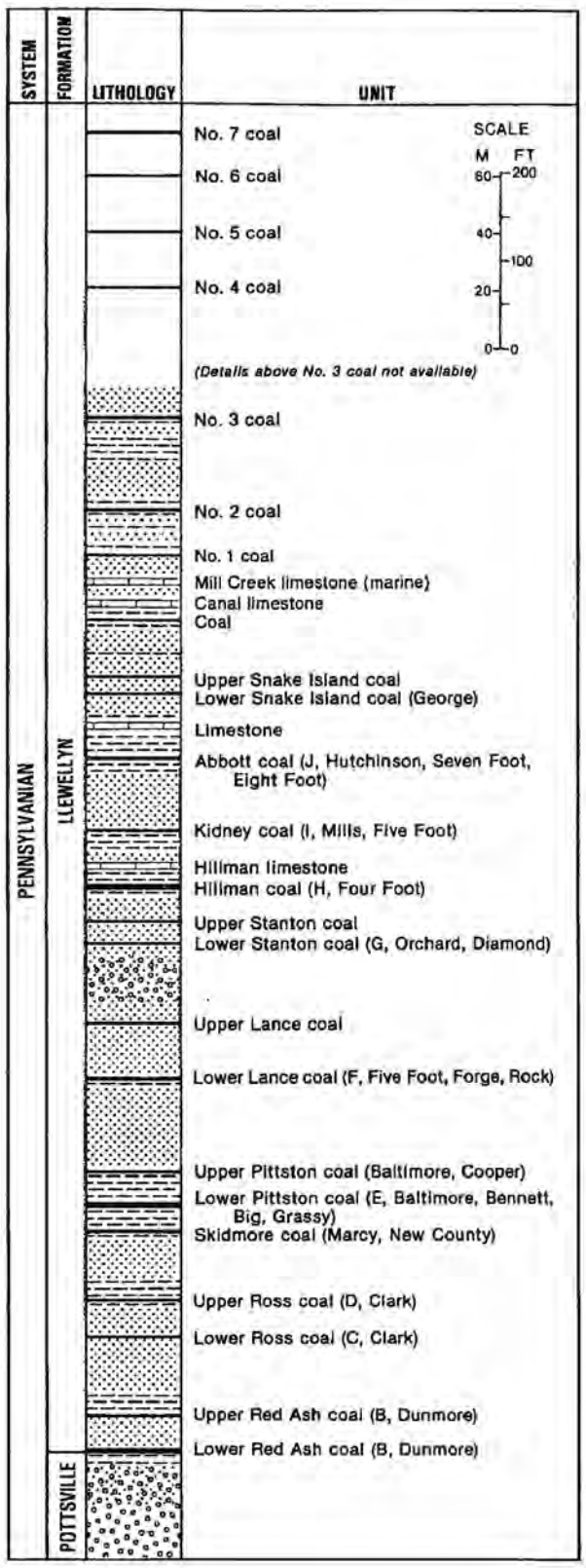


COLUMNAR SECTIONS

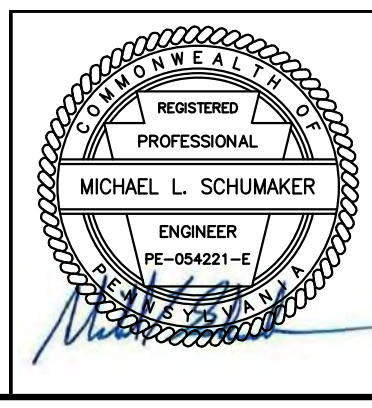
COLUMNAR SECTION LOCATION MAP



EXCERPT FROM: PART II. STRATIGRAPHY AND SEDIMENTARY TECTONICS CHAPTER 10 PENNSYLVANIAN



GENERALIZED STRATIGRAPHIC SECTION OF THE LLEWELLYN FORMATION OF THE NORTHERN ANTHRICITE FIELD



REFERENCES

1. SHAFT LOCATIONS OBTAINED FROM DEP MINE MAP "geor_BMSA_6816_001.SID"
2. HILL, F.A., 1888, "COLUMNAR SECTIONS OF THE COAL MEASURES IN THE VICINITY OF WYOMING AND PITTSTON, LUZERNE COUNTY", GEOLOGICAL SURVEY OF PENNSYLVANIA NORTHERN COAL FIELD COLUMNAR SECTION SHEET NO. VI
3. EDMUNDS, W. E., ET AL., PART II STRATIGRAPHY AND SEDIMENTARY TECTONICS, CHAPTER 10 PENNSYLVANIAN, FIGURE 10-17
4. PENNSYLVANIA DEP, BUREAU OF DISTRICT MINING OPERATIONS, DIGITIZED MINED AREAS, 2018

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TRANSCONTINENTAL GAS PIPELINE CO., LLC
REGIONAL ENERGY ACCESS PIPELINE
LUZERNE AND MONROE COUNTIES
PENNSYLVANIA

REGIONAL ENERGY LATERAL COAL COLUMNAR SECTIONS

DRAWN BY:	HCC	CHECKED BY:	KID	APPROVED BY: * Hand signature on file	MLS*	FIGURE NO:	3
DATE:	9/30/2020	SCALE:	REFER TO SCALE BAR	PROJECT NO:	303-105		

ATTACHMENT B-2
COMPRESSOR STATION 200

September 4, 2020

Mr. Brent Baldwin, P.E.
Transcontinental Gas Pipe Line Company, LLC
2800 Post Oak Blvd.
Houston, TX 77056

Dear Mr. Baldwin:

Subject: Geotechnical Engineering Letter Report
Geohazard Assessment for Compressor Station 200
East Whiteland Township, Chester County, Pennsylvania
CEC Project 303-863.0200

Civil & Environmental Consultants, Inc. (CEC) presents to Transcontinental Gas Pipe Line Company, LLC (Transco) the findings and recommendations associated with the subject project. CEC developed this report to summarize our literature review and to present generalized opinions and recommendations for implementing best management practices to address potential geohazards during construction. Attachments to this report include Attachment A – "Important Information about Your Geotechnical Engineering Report" and Attachment B – Figure 1.

The following sections of this report include a discussion, data obtained, conclusions and recommendations, standard of care and report limitations, and closing remarks.

1.0 DISCUSSION

Transco is proposing modifications to the existing Compressor Station 200 Facility in conjunction with the REA Facilities project. The Compressor Station 200 Facility is located in East Whiteland Township, Chester County, Pennsylvania.

2.0 DATA OBTAINED

2.1 Desktop Literature Review

CEC conducted a desktop literature review to identify and evaluate potentially hazardous naturally occurring geologic formations and soil conditions (geohazards) that may be encountered during the project limits. The information reviewed was relative to soil types, geology, landslides, slope gradients, karst geology/sinkholes, radioactive or arsenic bearing formations, mining, and coal outcrops. CEC's purpose in reviewing these documents was to identify potential areas for further field study and, where appropriate, provide recommendations to reduce the risk of ground movement or environmental impact due to naturally occurring geohazards during and after new proposed construction.

CEC reviewed the following publically available information to identify potential geohazard areas that may be encountered along the project limits:

- Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 59, "Glacial Deposits of Pennsylvania."
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 64, "Surficial Materials of Pennsylvania."
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 13, "Physiographic Provinces of Pennsylvania."
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 7, "Geologic Map of Pennsylvania."
- United States Geological Survey (USGS), Geologic Map of Pennsylvania - Map 1, dated 1980.
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources, "Density of Mapped Karst Features in South-Central and Southeastern Pennsylvania."
- Commonwealth of Pennsylvania Department of Conservation and Natural Resources, "Pennsylvania Geologic Data Exploration (PaGEODE)" (web-mapping application) accessed 8/19/20.
- Pennsylvania Geological Society publication "Landslides in Pennsylvania."
- Existing topographic contour information from PAMAP Program, Light Detection and Ranging (LiDAR) data, dated 2006.
- U.S. Department of Agriculture, National Resources Conservation Service, Custom Soil Resource Report for Chester County, Pennsylvania, prepared on 8/19/20 on the Web Soil Survey website. http://websoilsurvey.nrcs.usda.gov
- Pennsylvania Mine maps Atlas, The Pennsylvania State University. Accessed 8/19/2020. www.minemaps.psu.edu
- Commonwealth of Pennsylvania Department of Conservation and Natural Resources Bureau of Topographic and Geologic Survey, "Distribution of Pennsylvania Coals." Map 11. Third Edition, Revised, 2000.
- Pennsylvania Department of Environment Protection (PADEP), Mine Subsidence Insurance Program, Check for Risk Application (Online).
- United States Environmental Protection Agency (USEPA), Map of Radon Zones (Online).
- USGS Open-File Report 2014–1082 "Geochemical and Mineralogical Maps for Soils of the Conterminous United States," dated 2014.

Sections 2.2 through 2.8 present pertinent data obtained from the material referenced above for the Compressor Station 200 permanent footprint and temporary workspace.

2.2 Soils

Within the proposed ROW referenced in Section 1.0, the soil survey for Chester County indicates soils consists of the Urban land-Conestoga Complex (pavement, buildings, or other artificially covered areas). According to the Commonwealth of Pennsylvania Department of Conservation of

Natural Resources (DCNR) Map 64, "Surficial Materials of Pennsylvania", the near surface soils within the proposed limits of disturbance at the Compressor Station 200 Facility consist of moderately thick residuum covering the surface but bedrock outcrops are locally common.

2.3 Landslide Mapping

According to the DCNR report titled "Landslides in Pennsylvania", the Compressor Station 200 site location is not located within an area identified as being landslide susceptible. The area is categorized as a zone of low susceptibility for landslides except during times of heavy precipitation or after alteration of surface conditions by construction.

2.4 Topography

CEC performed a qualitative review of the topography within the proposed site limit of disturbance (LOD). This review was performed in conjunction with the review of the other desktop references pertaining to surficial and bedrock geology as discussed throughout this letter report. CEC considered, in a qualitative manner, the potential impact of standard pipeline construction practices on soil and rock strength. The actions of trenching and development of the construction right-of-way have the potential to create situations where relatively strong bedrock or stiff to hard residual soils that existed before construction are replaced with less competent backfill, when compared to undisturbed natural soil and bedrock, after construction. CEC also qualitatively considered how typical construction practices have the potential to influence groundwater flow patterns, such as by potentially concentrating groundwater flow in pipe trenches, in construction and post-construction conditions. The existing site is relatively flat, varying in elevation from approximately 386 ft to 382 ft, from the west to east, respectively.

2.5 Bedrock Geology

2.5.1 Stratigraphy

According to the USGS and DCNR online sources, stratigraphic rock units present at or near the surface within the proposed site LOD belong to the Cambrian aged, Ledger formation. This formation consists of light-gray, locally mottled, massive, pure, coarsely crystalline dolomite. It is also siliceous in the middle part of the formation.

2.5.2 Karst Topography

CEC reviewed DCNR mapping to identify the presence of soluble limestone and karst geologic features indicative of limestone solution. According to the reviewed mapping the site is located in an area with carbonate rock at the ground surface. The density of mapped karst features estimates a karst density of approximately 2 to 3 karst features per acre in the lowland of Chester County.

2.6 Mining and Coal Conditions

2.6.1 Surface and Deep Mining

According to the resources listed above, commercially mined coal seams will not be encountered at the site and surface or deep-mining activities have not occurred within the LOD.

2.6.2 Acid Producing Rock

Bedrock excavated as part of mining activities commonly possesses characteristics of APR. However as discussed, the proposed LOD is not located in an area that has been previously strip mined and/or deep-mined. Therefore, the need to manage APR during construction activities is not anticipated.

2.7 Radioactive Soils/Bedrock

Common sources of radioactivity in soil and rock include uranium-bearing minerals and oxides formed through the action of weathering. The largest concentrations of uranium-bearing minerals occur in organic rich black shales, ultramafic igneous rocks, and soils derived from these sources. These sources are not present in the compressor station LOD.

The most common geologic hazard associated with radioactive soils and rock is the occurrence of radon, a naturally occurring daughter product that occurs as an intermediate step in the normal radioactive decay of uranium. Radon is a colorless, odorless gas that can cause health effects due to the release of alpha particles, especially when allowed to accumulate in enclosed spaces. According to the United States Environmental Protection Agency (USEPA) Map of Radon Zones, the proposed site is at a low potential risk for radon in indoor air. Radon accumulation in outdoor work areas such as pipe trenches and excavations is not anticipated.

2.8 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of these natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

No mining activities have been identified within the proposed LOD. It is unlikely that coal bearing rock stratum will be encountered during construction. If encountered, coal and coal associated units will likely be weathered and excavation activities are not anticipated to generate appreciable amounts of material with potentially elevated arsenic.

3.0 CONCLUSIONS AND RECOMMENDATIONS

CEC notes that the opinions presented herein are based on CEC's review of published documents and reliable web resources. CEC recommends that field conditions be observed by a field representative under the direction of a professional geotechnical engineer during construction to determine if new geohazards have manifested, verify the opinions presented herein, and provide additional recommendations as needed. Based on the conclusions presented, CEC anticipates limited geohazard mitigation measures may need to be incorporated in site development plans and/or be necessary, pending inspection of field conditions under the direction of a professional geotechnical engineer during construction.

3.1 Surficial Geology and Groundwater

Based on CEC's research of historic landslide activity as well as landslide susceptible areas at the site, CEC concludes that the proposed construction will not occur in landslide susceptible soils.

The reviewed topography within the proposed site LOD, showed that the area of proposed development is relatively flat. CEC concludes that there is little to no risk of slope instability due to construction activity.

Surface water best management practices should be implemented according to the erosion and sedimentation control plans for controlling soil erosion thereby reducing the risk of slope or excavation instability. Site development design plans should specify that new embankments be constructed as compacted fills and incorporate toe keys and drainage measures to provide long-term slope stability.

3.2 Karst Topography

CEC reviewed USGS geologic descriptions of the site bedrock formations and available mapping of known karst bedrock, and concludes that there is a limited risk of karst feature development in the site soil and bedrock units. This is due to the regularity in distribution of susceptible strata (soluble limestone and other carbonate rocks) and their thickness within the site bedrock formations noted in Section 2.5.2. The presence of mapped karst features in Chester County, PA also supports this conclusion. Should soluble limestone or other carbonate rocks be encountered, surface water best management practices should be implemented according to the erosion and sedimentation control plans to provide positive surface water drainage away from building areas, excavations, and exposed rock at all times before, during, and after construction. Stormwater management plans should also incorporate use of watertight joints in piping and consideration of potential adverse impacts of infiltration, if used. If bedrock is encountered, excavation other than blasting should be implemented, and excavations should be closed as soon as possible after exposure. Any proposed water utility trenches should be lined to prevent infiltration, and/or underground piping should be leak proof and utilize gasketed joints. Should sinkholes or other subsidence conditions occur, a geotechnical engineer should be notified to investigate in further detail and provide appropriate remedial recommendations.

3.3 Mining

According to the references reviewed, commercially mined coal seams will not be encountered at the site and surface or deep-mining activities have not occurred within the LOD. CEC concludes that there is no risk of subsidence occurring.

3.4 Acid Producing Rock

CEC does not does not anticipate that coal or APR will be encountered during construction. However, if coal or other APR is encountered in sufficient concentrations, it can be mitigated in accordance with PADEP guidelines. If potentially APR is encountered in excavated shale the contractor should immediately notify Transco. Such materials should be handled in accordance with Pennsylvania Department of Environment Protection (PADEP) document No. 5600-FS-DEP4284, "How to Avoid and Handle Acid-Producing Rock Formations Encountered during Well Site Development".

3.5 Radioactive Soils/Bedrock

CEC reviewed information regarding radioactive soils and bedrock at the site, and anticipates that it is unlikely that the soils and rock present within the proposed compressor station LOD contain elevated levels of radioactivity. The proposed construction activities are not anticipated to result in potential accumulation of radon gas, the most common hazard associated with naturally occurring radioactive decay. CEC recommends that construction safety protocols consider radon accumulation in confined excavations and below grade structures.

3.6 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of these natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

Commercially mineable coal seams will not be encountered and mining activities have not been identified at the proposed compressor station project site. As such, CEC anticipates the there is a low risk of encountering arsenic bearing soils/rock during construction.

4.0 RECOMMENDATIONS

The following recommendations should be incorporated during construction to address geohazards within the proposed site LOD.

4.1 Oversight and Monitoring

4.1.1 Construction Oversight

The data collected and opinions presented in this report are based on CEC's review of published documents and the limited insight into the site surface and subsurface conditions that could be garnered during our desktop geohazard assessment. CEC recommends having geotechnical personnel on-site during construction in areas where geohazard mitigation measures are recommended. This allows a geotechnical engineer to evaluate the actual subsurface conditions encountered during construction, assess the appropriateness of the recommendations, modify recommendations when required, modify the locations of mitigation measures where required, and confirm CEC's recommendations are being correctly implemented.

5.0 POST-CONSTRUCTION MONITORING

CEC recommends that the areas described herein and additional areas of interest generated during construction are visually monitored by trained personnel under the supervision of a geotechnical engineer for signs of subsidence or instability. Field conditions related to landslides and karst geology induced subsidence features can evolve over long periods of time. CEC recommends periodic monitoring of field conditions in areas where drainage causes water to pool. Periodic monitoring of subsidence features can be conducted concurrently with other asset inspections.

6.0 STANDARD OF CARE AND REPORT LIMITATIONS

This letter report was prepared for the purpose of design review. Reliance on this letter report by any party other than Transco, its authorized agents, or the PADEP is expressly forbidden. Contractors should not rely on the conclusions and interpretations in this letter report for purposes 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 this opportunity to be of service to Transco. Please call if you have any questions or comments.

Very truly yours,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Kuchanda Dy, P.E.
Assistant Project Manager

Michael L. Schumaker, P.E.
Principal

Attachment A – Important Information about This Geotechnical-Engineering Report
Attachment B – Figure

303-863.0200-LR-GEOT-9.4.20

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 not 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 Not 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 not 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 not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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

ATTACHMENT B

FIGURE

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

LEGEND

- SURVEY CORRIDOR
- TEMPORARY WORKSPACE
- PERMANENT FOOTPRINT
- WATERBODY
- INDEX CONTOUR - 10 FT
- INTERMEDIATE CONTOUR - 2 FT

KARST FEATURE

- SINKHOLE
- SURFACE DEPRESSION

ELEVATION GRADIENT

EL. 570 — EL. 220

REFERENCES

1. TOPOGRAPHY DERIVED FROM 2015 U.S. GEOLOGICAL SURVEY DIGITAL ELEVATION MODEL (DEM) FOR CHESTER COUNTY, PENNSYLVANIA. TOPOGRAPHIC CONTOURS MAPPED AT A 2 FT INTERVAL.
2. KARST DATA OBTAINED FROM PENNSYLVANIA DCNR DIGITAL DATA SET OF MAPPED KARST FEATURES IN SOUTH-CENTRAL AND SOUTHEASTERN PENNSYLVANIA; DATED: 2007.
3. WATERBODY DATA OBTAINED FROM U.S. FISH AND WILDLIFE SERVICE NATIONAL WETLANDS INVENTORY (NWI) DATABASE FOR PENNSYLVANIA, 2016
4. FACILITY BOUNDARIES OBTAINED FROM WILLIAMS MIDSTREAM SERVICES, LLC TITLED "REA FACILITIES_RID_302_07172020.KMZ" ON 08/17/2020

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www.cecinc.com

DRAWN BY:	HCC	CHECKED BY:	KID	APPROVED BY: * Hand signature on file	MLS*
DATE:	9/8/2020	SCALE:	1 " = 325 '	PROJECT NO:	303-863

TRANSCONTINENTAL GAS PIPELINE COMPANY, LLC
REGIONAL ENERGY ACCESS FACILITIES
EAST WHITELAND TOWNSHIP
CHESTER COUNTY, PENNSYLVANIA

COMPRESSOR STATION 200 GEOHAZARD ASSESSMENT

FIGURE NO: **1**

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ATTACHMENT B-3
COMPRESSOR STATION 515

September 4, 2020

Mr. Brent Baldwin, P.E.
Transcontinental Gas Pipe Line Company, LLC
2800 Post Oak Blvd.
Houston, TX 77056

Dear Mr. Baldwin:

Subject: Geotechnical Engineering Letter Report
Geohazard Assessment for Compressor Station 515
Buck Township, Luzerne County, Pennsylvania
CEC Project 303-863.0201

Civil & Environmental Consultants, Inc. (CEC) presents to Transcontinental Gas Pipe Line Company, LLC (Transco) the findings and recommendations associated with the subject project. CEC developed this report to summarize our literature review and to present generalized opinions and recommendations for implementing best management practices to address potential geohazards during construction. Attachments to this report include Attachment A – "Important Information about Your Geotechnical Engineering Report" and Attachment B – Figure 1.

The following sections of this report include a discussion, data obtained, conclusions and recommendations, standard of care and report limitations, and closing remarks.

1.0 DISCUSSION

Transco is proposing to expand the existing Compressor Station 515 with the installation of a new compressor and modifications to the existing compressors in conjunction with the REA Facilities project. Compressor Station 515 is located in Buck Township, Luzerne County, Pennsylvania.

2.0 DATA OBTAINED

2.1 Desktop Literature Review

CEC conducted a desktop literature review to identify and evaluate potentially hazardous naturally occurring geologic formations and soil conditions (geohazards) that may be encountered during the project limits. The information reviewed was relative to soil types, geology, landslides, slope gradients, karst geology/sinkholes, radioactive or arsenic bearing formations, mining, and coal outcrops. CEC's purpose in reviewing these documents was to identify potential areas for further field study and, where appropriate, provide recommendations to reduce the risk of ground movement or environmental impact due to naturally occurring geohazards during and after the new proposed construction.

CEC reviewed the following publically available information to identify potential geohazard areas that may be encountered along the project limits:

- United States Department of Agriculture (USDA), On-line Soil Survey Geographic Database for Luzerne County, Pennsylvania
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 59, "Glacial Deposits of Pennsylvania"
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 64, "Surficial Materials of Pennsylvania"
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 13, "Physiographic Provinces of Pennsylvania"
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 7, "Geologic Map of Pennsylvania"
- United States Geological Survey (USGS), Geologic Map of Pennsylvania - Map 1, dated 1980 (online)
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources, "Density of Mapped Karst Features in South-Central and Southeastern Pennsylvania"
- Commonwealth of Pennsylvania Department of Conservation and Natural Resources, "Pennsylvania Geologic Data Exploration (PaGEODE)" (web-mapping application)
- Commonwealth of Pennsylvania's Department of Conservation and Natural Resource's Mapping, "Landslides in Pennsylvania."
- Existing topographic contour information from PAMAP Program, Light Detection and Ranging (LiDAR) data, dated 2006
- Department of Internal Affairs Topographic and Geologic Survey, "Map of the Coal Fields of Pennsylvania"
- Pennsylvania Department of Environment Protection (PADEP), Mine Subsidence Insurance Program, Check for Risk Application (Online)
- United States Environmental Protection Agency (USEPA), Map of Radon Zones (Online)
- USGS Open-File Report 2014–1082 "Geochemical and Mineralogical Maps for Soils of the Conterminous United States," dated 2014

Sections 2.2 through 2.8 present pertinent data obtained from the material referenced above for the Compressor Station 515 permanent footprint and temporary workspace.

2.2 Soils

Within the proposed permanent footprint and temporary workspace for Compressor Station 515 referenced in Section 1.0, the soil survey for Luzerne County indicates soils consisting of loamy till (soil deposited by glaciers) derived mainly from sandstone, siltstone, and shale. According to the Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 64, "Surficial Materials of Pennsylvania", the near surface soils within the proposed limits of disturbance (LOD) at Compressor Station 515 consist of sandy glacial diamict, described as having a moderate to abundant silt and sand matrix, along with minimal clay. The diamict overlies

sandstone bedrock and has usually experienced minimal weathering, has thin soil development, and has suffered little erosion. Deposits of less than 3 feet are most common.

2.3 Landslide Mapping

According to the DNCR, "Landslides in Pennsylvania", the site location of Compressor Station 515 is not located within and area identified as being landslide susceptible. The area categorized as a zone of low susceptibility for landslides except during times of heavy precipitation or after alteration of surface conditions by construction.

2.4 Topography

CEC performed a qualitative review of the topography within the proposed site limit of disturbance (LOD). This review was performed in conjunction with the review of the other desktop references pertaining to surficial and bedrock geology as discussed throughout this letter report. CEC considered, in a qualitative manner, the potential impact of standard pipeline construction practices on soil and rock strength. The actions of trenching and development of the construction right-of-way have the potential to create situations where relatively strong bedrock or stiff to hard residual soils that existed before construction are replaced with less competent backfill, when compared to undisturbed natural soil and bedrock, after construction. CEC also qualitatively considered how typical construction practices have the potential to influence groundwater flow patterns, such as by potentially concentrating groundwater flow in pipe trenches, in construction and post-construction conditions.

According to topographic mapping, the site generally consists of nearly level terrain. Drainage features/tributaries are present south of the proposed LOD.

2.5 Bedrock Geology

2.5.1 Stratigraphy

Stratigraphic rock units present at or near the surface within the proposed site LOD belong to the Mississippian aged, Pocono Formation. The Pocono Formation consists of light to olive-grey, cross bedded sandstone, siltstone, and conglomerate. It also contains areas of siltstone, dark shale, and very coaly horizons.

2.5.2 Karst Topography

CEC reviewed DCNR mapping to identify the presence of soluble limestone and karst geologic features indicative of limestone solution. According to the reviewed mapping, there are no documented sinkholes or surface depressions in Luzerne County, PA, where the existing compressor facility is located.

2.6 Mining and Coal Conditions

2.6.1 Surface and Deep Mining

According to the resources listed above, commercially mined coal seams will not be encountered at the site and surface or deep-mining activities have not occurred within the LOD.

2.6.2 Acid Producing Rock

Bedrock excavated as part of mining activities commonly possesses characteristics of APR. However, as discussed the proposed LOD is not located in an area that has been previously strip mined and/or deep-mined. Therefore, the need to manage APR during construction activities is not anticipated.

2.7 Radioactive Soils/Bedrock

Common sources of radioactivity in soil and rock include uranium-bearing minerals and oxides formed through the action of weathering. The largest concentrations of uranium-bearing minerals occur in organic rich black shales, ultramafic igneous rocks, and soils derived from these sources. Of these potential sources, only shales and shale derived soils are present in the compressor station LOD. The shale units present in the project area are typically not organic rich in nature.

The most common geologic hazard associated with radioactive soils and rock is the occurrence of radon, a naturally occurring daughter product that occurs as an intermediate step in the normal radioactive decay of uranium. Radon is a colorless, odorless gas that can cause health effects due to the release of alpha particles, especially when allowed to accumulate in enclosed spaces. According to the United States Environmental Protection Agency (USEPA) Map of Radon Zones, the proposed compressor station location is at an elevated potential risk for radon in indoor air. Radon accumulation in outdoor work areas such as pipe trenches and excavations is not anticipated.

2.8 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of these natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

No mining activities have been identified within the LOD of the compressor station. It is unlikely that coal bearing rock stratum will be encountered during construction. If encountered, coal and coal associated units will likely be weathered and excavation are not anticipated to generate appreciable amounts of material with potentially elevated arsenic.

3.0 CONCLUSIONS AND RECOMMENDATIONS

CEC notes that the opinions presented herein are based on CEC's review of published documents and reliable web resources. CEC recommends that field conditions be observed by a field representative under the direction of a professional geotechnical engineer during construction to determine if new geohazards have manifested, verify the opinions presented herein, and provide additional recommendations as needed. Based on the conclusions presented, CEC anticipates the following limited geohazard mitigation measures may need to be incorporated in site development plans and/or be necessary, pending inspection of field conditions under the direction of a professional geotechnical engineer during construction.

3.1 Surficial Geology and Groundwater

Based on CEC's research of historic landslide activity as well as landslide susceptible areas at the site, CEC concludes that the proposed compressor station construction will not occur in landslide susceptible soils. Surface water best management practices should be implemented according to the erosion and sedimentation control plans for controlling soil erosion thereby reducing the risk of slope or excavation instability. Site development design plans should specify that new embankments be constructed as compacted fills and incorporate toe keys and drainage measures to provide long-term slope stability.

3.2 Karst Topography

CEC reviewed USGS geologic descriptions of the site bedrock formations and available mapping of known karst bedrock, and determined that the risk for karst formations in the site soil and bedrock units is low. This is based on the lack of geologic features indicative of karst topography on the mapping reviewed.

3.3 Mining

According to the references reviewed, commercially mined coal seams will not be encountered at the site and surface or deep-mining activities have not occurred within the LOD. CEC concludes that there is little to no risk of subsidence occurring.

3.4 Acid Producing Rock

CEC does not does not anticipate that coal or APR will be encountered during construction. However, if coal or other APR is encountered in sufficient concentrations, it can be mitigated in accordance with PADEP guidelines. If potentially APR is encountered in excavated shale the contractor should immediately notify Transco. Such materials should be handled in accordance with Pennsylvania Department of Environment Protection (PADEP) document No. 5600-FS-DEP4284, "How to Avoid and Handle Acid-Producing Rock Formations Encountered during Well Site Development".

3.5 Radioactive Soils/Bedrock

CEC reviewed information regarding radioactive soils and bedrock at the site, and anticipates that it is unlikely that the soils and rock present within the proposed compressor station LOD contain elevated levels of radioactivity. The proposed construction activities are not anticipated to result in potential accumulation of radon gas, the most common hazard associated with naturally occurring radioactive decay. CEC recommends that construction safety protocols consider radon accumulation in confined excavations and below grade structures.

3.6 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of these natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

Commercially mineable coal seams will not be encountered and mining activities have not been identified at the proposed compressor station project site. As such, CEC anticipates the there is a low risk of encountering arsenic bearing soils/rock during construction.

4.0 RECOMMENDATIONS

The following recommendations should be incorporated during construction to address geohazards within the proposed site LOD.

4.1 Oversight and Monitoring

4.1.1 Construction Oversight

The data collected and opinions presented in this report are based on CEC's review of published documents and the limited insight into the site surface and subsurface conditions that could be garnered during our desktop geohazard assessment. CEC recommends having geotechnical personnel on-site during construction in areas where geohazard mitigation measures are recommended. This allows a geotechnical engineer to evaluate the actual subsurface conditions encountered during construction, assess the appropriateness of the recommendations, modify recommendations when required, modify the locations of mitigation measures where required, and confirm CEC's recommendations are being correctly implemented.

5.0 POST-CONSTRUCTION MONITORING

CEC recommends that the areas described herein and additional areas of interest generated during construction are visually monitored by trained personnel under the supervision of a geotechnical engineer for signs of subsidence or instability. Field conditions related to landslides and karst geology induced subsidence features can evolve over long periods of time. CEC recommends

periodic monitoring of field conditions in areas where drainage causes water to pool. Periodic monitoring can be conducted concurrently with other asset inspections.

6.0 STANDARD OF CARE AND REPORT LIMITATIONS

This letter report was prepared for the purpose of design review. Reliance on this letter report by any party other than Transco or its authorized agents is expressly forbidden. Contractors should not rely on the conclusions and interpretations in this letter report for purposes 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 this opportunity to be of service to Transco. Please call if you have any questions or comments.

Very truly yours,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Kuchanda Dy, P.E.
Assistant Project Manager

Michael L. Schumaker, P.E.
Principal

Attachment A – Important Information about This Geotechnical-Engineering Report
Attachment B – Figure

303-863.0201-LR-GEOT-09-4-20

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 not 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 Not 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

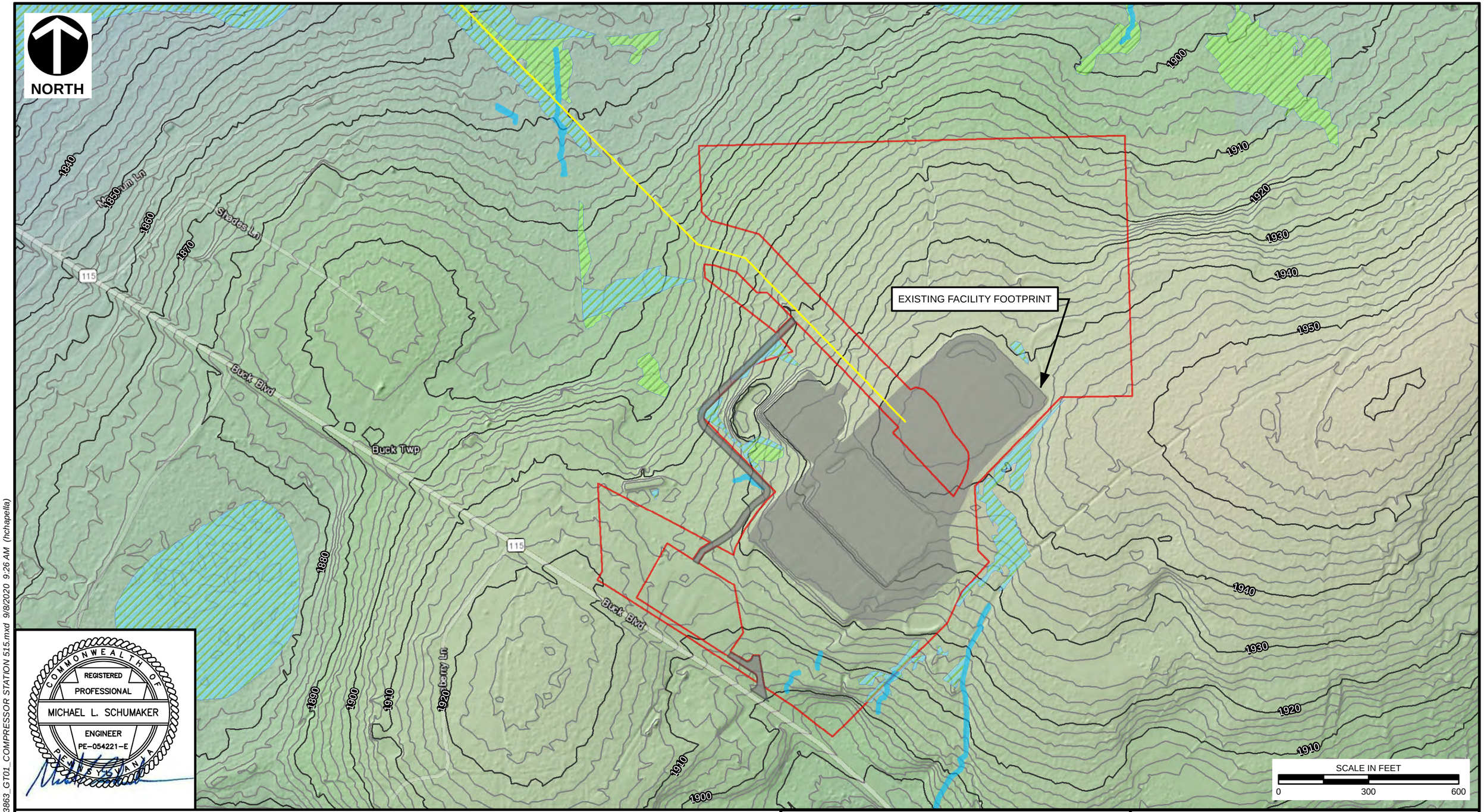
While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not 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 not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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

ATTACHMENT B

FIGURE



COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

LEGEND

- PROPOSED GAS CENTERLINE
- TEMPORARY WORKSPACE
- EXISTING FACILITY FOOTPRINT
- PROPOSED ACCESS ROAD
- EMERGENT WETLAND
- FORESTED WETLAND
- STREAM
- INDEX CONTOUR - 10FT
- INTERMEDIATE CONTOUR - 2FT

ELEVATION GRADIENT

EL. 1962 – EL. 1790

REFERENCE(S)

1. TOPOGRAPHY DERIVED FROM 2017 SOUTH CENTRAL PENNSYLVANIA LiDAR DIGITAL ELEVATION MODEL (DEM). TOPOGRAPHIC CONTOURS MAPPED AT A 2 FT INTERVAL.
2. WETLAND AND STREAM DATA OBTAINED FROM U.S. FISH AND WILDLIFE SERVICE NATIONAL WETLANDS INVENTORY (NWI) DATABASE FOR PENNSYLVANIA, 2016 AND ENHANCED WITH SURVEYED DELINEATIONS FOR TRANSCO. IN 2019
3. FACILITY BOUNDARY DATA OBTAINED FROM WILLIAMS MIDSTREAM SERVICES, LLC TITLED "REA FACILITIES_RID_302_07172020.kmz" ON 8/17/2020

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TRANSCONTINENTAL GAS PIPELINE COMPANY, LLC
REGIONAL ENERGY ACCESS FACILITIES
BUCK TOWNSHIP
LUZERNE COUNTY, PENNSYLVANIA

COMPRESSOR STATION 515 GEOHAZARD ASSESSMENT

DRAWN BY:	HCC	CHECKED BY:	KID	APPROVED BY:	* Hand signature on file MLS*	FIGURE NO:	1
DATE:	9/8/2020	SCALE:	1 " = 300 '	PROJECT NO:	303-863		

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ATTACHMENT B-4
DELAWARE RIVER REGULATOR

September 4, 2020
(Revised October 9, 2020)

Ms. Michelle Mumme, P.E.
Transcontinental Gas Pipe Line Company, LLC
2800 Post Oak Blvd.
Houston, TX 77056

Dear Ms. Mumme:

Subject: Geotechnical Engineering Letter Report
Geohazard Assessment for Delaware River Regulator Facility
Lower Mt. Bethel Township, Northampton County, Pennsylvania
CEC Project 303-863.0100

Civil & Environmental Consultants, Inc. (CEC) presents to Transcontinental Gas Pipe Line Company, LLC (Transco) the findings and recommendations associated with the subject project. CEC developed this revised report to summarize our literature review and to present generalized opinions and recommendations for implementing best management practices to address potential geohazards during construction. The report was revised to reflect project layout changes. Attachments to this report include Attachment A – "Important Information about Your Geotechnical Engineering Report" and Attachment B – Figure 1.

The following sections of this report include a discussion, data obtained, conclusions and recommendations, standard of care and report limitations, and closing remarks.

1.0 DISCUSSION

Transco is proposing to modify the Delaware River Regulator Facility in conjunction with the REA Facilities project. Delaware River Regulator Facility is located in Lower Mt. Bethel Township, Northampton County, Pennsylvania.

2.0 DATA OBTAINED

2.1 Desktop Literature Review

CEC conducted a desktop literature review to identify and evaluate potentially hazardous naturally occurring geologic formations and soil conditions (geohazards) that may be encountered along the project limits. The information reviewed was relative to soil types and geology, landslides, slope gradients, karst geology/sinkholes, radioactive or arsenic bearing formations, mining, and coal outcrops. CEC's purpose in reviewing these documents was to identify potential areas for further field study and, where appropriate, provide recommendations to reduce the risk of ground movement or environmental impact due to naturally occurring geohazards during and after the new proposed construction.

CEC reviewed the following publically available information to identify potential geohazard areas that may be encountered along the project limits:

- United States Department of Agriculture (USDA), On-line Soil Survey Geographic Database for Luzerne County, Pennsylvania;
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 59, "Glacial Deposits of Pennsylvania";
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 64, "Surficial Materials of Pennsylvania";
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 13, "Physiographic Provinces of Pennsylvania";
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 7, "Geologic Map of Pennsylvania";
- United States Geological Survey (USGS), Geologic Map of Pennsylvania - Map 1, dated 1980 (online);
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources, "Density of Mapped Karst Features in South-Central and Southeastern Pennsylvania";
- Commonwealth of Pennsylvania Department of Conservation and Natural Resources, "Pennsylvania Geologic Data Exploration (PaGEODE)" (web-mapping application);
- Commonwealth of Pennsylvania's Department of Conservation and Natural Resource's Mapping, "Landslides in Pennsylvania."
- Existing topographic contour information from PAMAP Program, Light Detection and Ranging (LiDAR) data, dated 2006;
- Department of Internal Affairs Topographic and Geologic Survey, "Map of the Coal Fields of Pennsylvania"
- Pennsylvania Department of Environment Protection (PADEP), Mine Subsidence Insurance Program, Check for Risk Application (Online);
- United States Environmental Protection Agency (USEPA), Map of Radon Zones (Online);
- USGS Open-File Report 2014–1082 "Geochemical and Mineralogical Maps for Soils of the Conterminous United States," dated 2014;

Sections 2.2 through 2.9 present pertinent data obtained from the material referenced above for the Delaware River Regulator Facility permanent footprint and temporary workspace.

2.2 Soils

Within the proposed permanent footprint and temporary workspace for Delaware River Regulator Facility referenced in Section 1.0, the soil survey for Northampton County indicates soils consisting of residuum (soil weathered from parent bedrock) weathered from limestone and siltstone. According to the Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 64, "Surficial Materials of Pennsylvania", the near surface soils within the proposed limits of disturbance at the for Delaware River Regulator Facility consist of residuum weathered from carbonate rocks, described as commonly having both open and filled

sinkholes. Thin to moderately thick residuum covers most of the surface, but bedrock outcrops are locally common. Thin to moderately thick colluvium derived from adjacent, non-carbonate uplands occurs in some areas along the margins of the carbonate areas. Alluvium is generally thin in this surficial deposit.

2.3 Landslide Mapping

According to the DCNR report titled "Landslides in Pennsylvania", the Delaware River Regulator Facility site location is not located within an area identified as being landslide susceptible. The area is categorized as a zone of low susceptibility for landslides except during times of heavy precipitation or after alteration of surface conditions by construction.

2.4 Topography

CEC performed a qualitative review of the topography within the proposed site limit of disturbance (LOD). This review was performed in conjunction with the review of the other desktop references pertaining to surficial and bedrock geology as discussed throughout this letter report. CEC considered, in a qualitative manner, the potential impact of standard pipeline construction practices on soil and rock strength. The actions of trenching and development of the construction right-of-way have the potential to create situations where relatively strong bedrock or stiff to hard residual soils that existed before construction are replaced with less competent backfill, when compared to undisturbed natural soil and bedrock, after construction. CEC also qualitatively considered how typical construction practices have the potential to influence groundwater flow patterns, such as by potentially concentrating groundwater flow in pipe trenches, in construction and post-construction conditions. The existing slopes in the development area are approximately 7.5H:1:V.

2.5 Bedrock Geology

2.5.1 Stratigraphy

According to the USGS and DCNR online sources, stratigraphic rock units present at or near the surface within the proposed site LOD belong to the Ordovician aged, Jacksonburg Formation. The Jacksonburg Formation consists of dark-gray shaly limestone with slaty cleavage.

2.5.2 Karst Topography

CEC reviewed DCNR mapping to identify the presence of soluble limestone and karst geologic features indicative of limestone solution. According to the reviewed mapping the site is located in an area with carbonate rock at the ground surface. The density of mapped karst features estimates a karst density of less than 1 per 10 acres in this area of Northampton County, Pennsylvania.

2.6 Mining and Coal Conditions

2.6.1 Surface and Deep Mining

According to the resources listed above, commercially mined coal seams will not be encountered at the site and surface or deep-mining activities have not occurred within the LOD.

2.6.2 Acid Producing Rock

Bedrock excavated as part of mining activities commonly possesses characteristics of APR. However as discussed, the proposed LOD is not located in an area that has been previously strip mined and/or deep-mined. Therefore, the need to manage APR during construction activities is not anticipated.

2.7 Radioactive Soils/Bedrock

Common sources of radioactivity in soil and rock include uranium-bearing minerals and oxides formed through the action of weathering. The largest concentrations of uranium-bearing minerals occur in organic rich black shales, ultramafic igneous rocks, and soils derived from these sources. None of these potential sources are present in the regulator facility LOD.

The most common geologic hazard associated with radioactive soils and rock is the occurrence of radon, a naturally occurring daughter product that occurs as an intermediate step in the normal radioactive decay of uranium. Radon is a colorless, odorless gas that can cause health effects due to the release of alpha particles, especially when allowed to accumulate in enclosed spaces. According to the United States Environmental Protection Agency (USEPA) Map of Radon Zones, the regulator facility location is at an elevated potential risk for radon in indoor air. Radon accumulation in outdoor work areas such as pipe trenches and excavations is not anticipated.

2.8 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of these natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

No mining activities have been identified within the LOD of the regulator facility. It is unlikely that coal bearing rock stratum will be encountered during construction. If encountered, coal and coal associated units will likely be weathered and excavation activities are not anticipated to generate appreciable amounts of material with potentially elevated arsenic.

3.0 CONCLUSIONS AND RECOMMENDATIONS

CEC notes that the opinions presented herein are based on CEC's review of published documents and reliable web resources. CEC recommends that field conditions be observed by a field representative under the direction of a professional geotechnical engineer during construction to determine if new geohazards have manifested, verify the opinions presented herein, and provide additional recommendations as needed. Based on the conclusions presented, CEC anticipates limited geohazard mitigation measures may need to be incorporated in site development plans and/or be necessary pending inspection of field conditions under the direction of a professional geotechnical engineer during construction.

3.1 Surficial Geology and Groundwater

Based on CEC's research of historic landslide activity, as well as landslide susceptible areas at the site, CEC concludes that the regulator facility modification will not occur in landslide susceptible soils. Surface water best management practices should be implemented according to the erosion and sedimentation control plans for controlling soil erosion thereby reducing the risk of slope or excavation instability. Site development design plans should specify that new embankments be constructed as compacted fills and incorporate toe keys and drainage measures to provide long-term slope stability.

3.2 Karst Topography

CEC reviewed USGS geologic descriptions of the site bedrock formations and available mapping of known karst bedrock, and concludes that there is a limited risk of karst feature development in the site soil and bedrock units. This is due to the regularity in distribution of susceptible strata (soluble limestone and other carbonate rocks) and their thickness within the site bedrock formations noted in Section 2.5.2. The presence of mapped karst features in Northampton County, PA also supports this conclusion. Should soluble limestone or other carbonate rocks be encountered, surface water best management practices should be implemented according to the erosion and sedimentation control plans to provide positive surface water drainage away from building areas, excavations, and exposed rock at all times before, during, and after construction. Stormwater management plans should also incorporate use of watertight joints in piping and consideration of potential adverse impacts of infiltration, if used. If bedrock is encountered, excavation other than blasting should be implemented, and excavations should be closed as soon as possible after exposure. Any proposed water utility trenches should be lined to prevent infiltration, and/or underground piping should be leak proof and utilize gasketed joints. Should sinkholes or other subsidence conditions occur, a geotechnical engineer should be notified to investigate in further detail and provide appropriate remedial recommendations.

3.3 Mining

According to the references reviewed, commercially mined coal seams will not be encountered at the site and surface or deep-mining activities have not occurred within the LOD. CEC concludes that there is no risk of subsidence occurring.

3.4 Acid Producing Rock

CEC does not does not anticipate that coal or APR will be encountered during construction. However, if coal or other APR is encountered in sufficient concentrations, it can be mitigated in accordance with PADEP guidelines. If potentially APR is encountered in excavated shale the contractor should immediately notify Transco. Such materials should be handled in accordance with Pennsylvania Department of Environment Protection (PADEP) document No. 5600-FS-DEP4284, "How to Avoid and Handle Acid-Producing Rock Formations Encountered during Well Site Development".

3.5 Radioactive Soils/Bedrock

CEC reviewed information regarding radioactive soils and bedrock at the site, and anticipates that it is unlikely that the soils and rock present within the regulator facility LOD contain elevated levels of radioactivity. The proposed construction activities are not anticipated to result in potential accumulation of radon gas, the most common hazard associated with naturally occurring radioactive decay. CEC recommends that construction safety protocols consider radon accumulation in confined excavations and below grade structures.

3.6 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of these natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

Commercially mineable coal seams will not be encountered and mining activities have not been identified at the regulator facility project site. As such, CEC anticipates the there is a low risk of encountering arsenic bearing soils/rock during construction.

4.0 RECOMMENDATIONS

The following recommendations should be incorporated during construction to address geohazards within the proposed site LOD.

4.1 Oversight and Monitoring

4.1.1 Construction Oversight

The data collected and opinions presented in this report are based on CEC's review of published documents and the limited insight into the site surface and subsurface conditions that could be garnered during our desktop geohazard assessment. CEC recommends having geotechnical personnel on-site during construction in areas where geohazard mitigation measures are recommended. This allows a geotechnical engineer to evaluate the actual subsurface conditions encountered during construction, assess the appropriateness of the recommendations, modify recommendations when required, modify the locations of mitigation measures where required, and confirm CEC's recommendations are being correctly implemented.

5.0 POST-CONSTRUCTION MONITORING

CEC recommends that the areas described herein and additional areas of interest generated during construction are visually monitored by trained personnel under the supervision of a geotechnical engineer for signs of subsidence or instability. Field conditions related to landslides and karst geology induced subsidence features can evolve over long periods of time. CEC recommends periodic monitoring of field conditions in areas where drainage causes water to pool. Periodic monitoring of subsidence features can be conducted concurrently with other asset inspections.

6.0 STANDARD OF CARE AND REPORT LIMITATIONS

This letter report was prepared for the purpose of design review. Reliance on this letter report by any party other than Transco or its authorized agents is expressly forbidden. Contractors should not rely on the conclusions and interpretations in this letter report for purposes 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 this opportunity to be of service to Transco. Please call if you have any questions or comments.

Very truly yours,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Michael L. Schumaker, P.E. for:
Kuchanda Dy, P.E.
Assistant Project Manager

Michael L. Schumaker, P.E.
Principal

Attachment A – Important Information about This Geotechnical-Engineering Report
Attachment B – Figure

303-863.0100-LR-GEOT-10.9.20

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 not 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 Not 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 not 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 not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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

ATTACHMENT B

FIGURE

NORTH

MUD RUN DELINEATION OBTAINED FROM 2016 NWI DATA SET (REFERENCE 4)

EXISTING FACILITY FOOTPRINT

EXISTING FARM ROAD

Lower Mud Run Rd

Mud Run

SCALE IN FEET
0 200 400

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

LEGEND

- PROPOSED LIMIT OF DISTURBANCE
- PROPOSED TEMPORARY WORKSPACE
- PROPOSED ADDITIONAL TEMPORARY WORKSPACE
- PROPOSED ACCESS ROAD
- EXISTING FACILITY FOOTPRINT
- SURFACE DEPRESSION*
- QUARRY
- STREAM
- INDEX CONTOUR - 10 FT
- INTERMEDIATE CONTOUR - 2FT

ELEVATION GRADIENT
EL. 510
EL. 222

REFERENCES

1. TOPOGRAPHY DERIVED FROM 2008 PA MAP PROGRAM LiDAR ELEVATION MODEL (DEM). TOPOGRAPHIC CONTOURS MAPPED AT A 2 FT INTERVAL.
2. KARST DATA OBTAINED FROM PENNSYLVANIA DCNR DIGITAL DATA SET OF MAPPED KARST FEATURES IN SOUTH-CENTRAL AND SOUTHEASTERN PENNSYLVANIA; DATED: 2007.
3. U.S.D.A. SOIL SURVEY GEOGRAPHIC (SSURGO) DATABASE FOR NORTHHAMPTON COUNTY, PENNSYLVANIA; DATED: 2015
4. STREAM DATA OBTAINED FROM U.S. FISH AND WILDLIFE SERVICE NATIONAL WETLANDS INVENTORY (NWI) DATABASE FOR PENNSYLVANIA, 2016
5. FACILITY BOUNDARIES OBTAINED FROM WILLIAMS MIDSTREAM SERVICES, LLC TITLED "20201007 REA M&R PA Facilities.kmz" ON 10/07/2020.

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TRANSCONTINENTAL GAS PIPELINE COMPANY, LLC
REGIONAL ENERGY ACCESS FACILITIES
LOWER MT. BETHEL TOWNSHIP
NORTHAMPTON COUNTY, PENNSYLVANIA

DELAWARE RIVER REGULATOR GEOHAZARD ASSESSMENT

DRAWN BY:	HCC	CHECKED BY:	KID	APPROVED BY:	* Hand signature on file MLS*	FIGURE NO:	1
DATE:	10/8/2020	SCALE:	1 " = 200 '	PROJECT NO:	303-863		

P:\300-000\303-863\-GIS\Maps\303863_GT01_DELAWARE RIVER REGULATOR.mxd 10/8/2020 8:59 AM (hchapella)

ATTACHMENT B-5
MAINLINE A REGULATOR

September 4, 2020
(Revised October 9, 2020)

Ms. Michelle Mumme, P.E.
Transcontinental Gas Pipe Line Company, LLC
2800 Post Oak Blvd.
Houston, TX 77056

Dear Ms. Mumme:

Subject: Geotechnical Engineering Letter Report
Geohazard Assessment for Mainline A Regulator Facility
Makefield Township, Bucks County, Pennsylvania
CEC Project 303-863.0101

Civil & Environmental Consultants, Inc. (CEC) presents to Transcontinental Gas Pipe Line Company, LLC (Transco) the findings and recommendations associated with the subject project. CEC developed this revised report to summarize our literature review and to present generalized opinions and recommendations for implementing best management practices to address potential geohazards during construction. The report was revised to include figures with updates to the project layout. Attachments to this report include Attachment A – "Important Information about Your Geotechnical Engineering Report" and Attachment B – Figure 1.

The following sections of this report include a discussion, data obtained, conclusions and recommendations, standard of care and report limitations, and closing remarks.

1.0 DISCUSSION

Transco is proposing to modify the Mainline A Regulator Facility in conjunction with the REA Facilities project. The Mainline A Regulator Facility is located in Makefield Township, Bucks County, Pennsylvania.

2.0 DATA OBTAINED

2.1 Desktop Literature Review

CEC conducted a desktop literature review to identify and evaluate potentially hazardous naturally occurring geologic formations and soil conditions (geohazards) that may be encountered along the project limits. The information reviewed was relative to soil types and geology, landslides, slope gradients, karst geology/sinkholes, radioactive or arsenic bearing formations, mining, and coal outcrops. CEC's purpose in reviewing these documents was to identify potential areas for further field study and, where appropriate, provide recommendations to reduce the risk of ground movement or environmental impact due to naturally occurring geohazards during and after new proposed construction.

CEC reviewed the following publically available information to identify potential geohazard areas that may be encountered along the project limits:

- United States Department of Agriculture (USDA), On-line Soil Survey Geographic Database for Luzerne County, Pennsylvania;
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 59, "Glacial Deposits of Pennsylvania";
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 64, "Surficial Materials of Pennsylvania";
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 13, "Physiographic Provinces of Pennsylvania";
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 7, "Geologic Map of Pennsylvania";
- United States Geological Survey (USGS), Geologic Map of Pennsylvania - Map 1, dated 1980 (online);
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources, "Density of Mapped Karst Features in South-Central and Southeastern Pennsylvania";
- Commonwealth of Pennsylvania Department of Conservation and Natural Resources, "Pennsylvania Geologic Data Exploration (PaGEODE)" (web-mapping application);
- Commonwealth of Pennsylvania's Department of Conservation and Natural Resource's Mapping, "Landslides in Pennsylvania."
- Existing topographic contour information from PAMAP Program, Light Detection and Ranging (LiDAR) data, dated 2006;
- Department of Internal Affairs Topographic and Geologic Survey, "Map of the Coal Fields of Pennsylvania"
- Pennsylvania Department of Environment Protection (PADEP), Mine Subsidence Insurance Program, Check for Risk Application (Online);
- United States Environmental Protection Agency (USEPA), Map of Radon Zones (Online);
- USGS Open-File Report 2014–1082 "Geochemical and Mineralogical Maps for Soils of the Conterminous United States," dated 2014;

Sections 2.2 through 2.8 present pertinent data obtained from the material referenced above for the Mainline A Regulator Facility permanent footprint and temporary workspace.

2.2 Soils

Within the proposed permanent footprint and temporary workspace for the Mainline A Regulator Facility referenced in Section 1.0, the soil survey for Bucks County indicates soils consisting of glacial outwash (material carried away from a glacier by meltwater and deposited beyond the moraine) and alluvium (soil deposited by moving water in streams, rivers, and floodplains) weathered from sedimentary and metamorphic rock. According to the Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 64, "Surficial Materials of Pennsylvania", the near surface soils within the proposed limits of disturbance for the

Mainline A Regulator Facility consist of stratified sand and gravel, arranged in distinct layers. Stratified sand and gravel deposits include flat-surfaced deposits in valley bottoms and hummocky deposits along valley sides. The valley-bottom deposits are comprised of clay, silt, sand, and gravel, whereas the hummocky, valley-side deposits are comprised mainly of sand and gravel.

2.3 Landslide Mapping

According to the DCNR report titled, "Landslides in Pennsylvania", the Mainline A Regulator Facility site is not located within an area identified as being landslide susceptible. The area is categorized as a zone of low susceptibility for landslides except during times of heavy precipitation or after alteration of surface conditions by construction.

2.4 Topography

CEC performed a qualitative review of the topography within the proposed site limit of disturbance (LOD). This review was performed in conjunction with the review of the other desktop references pertaining to surficial and bedrock geology as discussed throughout this letter report. CEC considered, in a qualitative manner, the potential impact of standard pipeline construction practices on soil and rock strength. The actions of trenching and development of the construction right-of-way have the potential to create situations where relatively strong bedrock or stiff to hard residual soils that existed before construction are replaced with less competent backfill, when compared to undisturbed natural soil and bedrock, after construction. CEC also qualitatively considered how typical construction practices have the potential to influence groundwater flow patterns, such as by potentially concentrating groundwater flow in pipe trenches, in construction and post-construction conditions.

According to topographic mapping, the site generally consists of nearly level terrain situated near the bank of the Delaware River. Drainage features/tributaries are present south of the proposed LOD.

2.5 Bedrock Geology

2.5.1 Stratigraphy

Stratigraphic rock units present at or near the surface within the proposed site limit of disturbance (LOD) belong to the Triassic aged, Lockatong Formation. The Lockatong Formation consists of dark-gray to black, thick-bedded argillite containing a few zones of thin-bedded black shale, with local layers of thin impure limestone and calcareous shale.

2.5.2 Karst Topography

CEC reviewed DCNR mapping to identify the presence of soluble limestone and karst geologic features indicative of limestone solution. According to the reviewed mapping the site is located

in an area absent of carbonate rock at the surface. There are no documented sinkholes or surface depressions near the Mainline A Regulator Facility site location in Bucks County, PA

2.6 Mining and Coal Conditions

2.6.1 Surface and Deep Mining

According to the resources listed above, commercially mined coal seams will not be encountered at the site and surface or deep-mining activities have not occurred within the LOD.

2.6.2 Acid Producing Rock

Bedrock excavated as part of mining activities commonly possesses characteristics of APR. However as discussed, the proposed LOD is not located in an area that has been previously strip mined and/or deep-mined. Therefore, the need to manage APR during construction activities is not anticipated

2.7 Radioactive Soils/Bedrock

Common sources of radioactivity in soil and rock include uranium-bearing minerals and oxides formed through the action of weathering. The largest concentrations of uranium-bearing minerals occur in organic rich black shales, ultramafic igneous rocks, and soils derived from these sources. The Lockatong Formation is a potential source of radioactive soil/bedrock that is present near the Mainline A Regulator Facility LOD.

The most common geologic hazard associated with radioactive soils and rock is the occurrence of radon, a naturally occurring daughter product that occurs as an intermediate step in the normal radioactive decay of uranium. Radon is a colorless, odorless gas that can cause health effects due to the release of alpha particles, especially when allowed to accumulate in enclosed spaces. According to the United States Environmental Protection Agency (USEPA) Map of Radon Zones, the meter station location is at an elevated potential risk for radon in indoor air. Radon accumulation in outdoor work areas such as pipe trenches and excavations is not anticipated.

2.8 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of these natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

No mining activities have been identified within the LOD of the meter station. It is unlikely that coal bearing rock stratum will be encountered during construction. If encountered, coal and coal associated units will likely be weathered and excavation activities are not anticipated to generate an appreciable amount of material with potentially elevated arsenic.

3.0 CONCLUSIONS AND RECOMMENDATIONS

CEC notes that the opinions presented herein are based on CEC's review of published documents and reliable web resources. CEC recommends that field conditions be observed by a field representative under the direction of a professional geotechnical engineer during construction to determine if new geohazards have manifested, to verify the opinions presented herein, and provide additional recommendations as needed. Based on the conclusions presented, CEC anticipates limited geohazard mitigation measures may need to be incorporated in site development plans and/or be necessary, pending inspection of field conditions under the direction of a professional geotechnical engineer during construction.

3.1 Surficial Geology and Groundwater

Based on CEC's research of historic landslide activity as well as landslide susceptible areas at the site, CEC concludes that the Mainline A Regulator Facility modification will not occur in landslide susceptible soils. Surface water best management practices should be implemented according to the erosion and sedimentation control plans for controlling soil erosion thereby reducing the risk of slope or excavation instability. Site development design plans should specify that new embankments be constructed as compacted fills and incorporate toe keys and drainage measures to provide long-term slope stability.

3.2 Karst Topography

CEC reviewed USGS geologic descriptions of the site bedrock formations and available mapping of known karst bedrock, and determined that the risk for karst formations in the site soil and bedrock units is low.

3.3 Mining

According to the references reviewed, commercially mined coal seams will not be encountered at the site and surface or deep-mining activities have not occurred within the LOD. CEC concludes that there is no risk of subsidence occurring.

3.4 Acid Producing Rock

CEC does not does not anticipate that coal or APR will be encountered during construction. However, if coal or other APR is encountered in sufficient concentrations, it can be mitigated in accordance with PADEP guidelines. If potentially APR is encountered in excavated shale the contractor should immediately notify Transco. Such materials should be handled in accordance with Pennsylvania Department of Environment Protection (PADEP) document No. 5600-FS-DEP4284, "How to Avoid and Handle Acid-Producing Rock Formations Encountered during Well Site Development".

3.5 Radioactive Soils/Bedrock

CEC reviewed information regarding radioactive soils and bedrock at the site, and anticipates that it is unlikely that the soils and rock present within the Mainline A Regulator Facility LOD contain elevated levels of radioactivity. The proposed construction activities are not anticipated to result in potential accumulation of radon gas, the most common hazard associated with naturally occurring radioactive decay. CEC recommends that construction safety protocols consider radon accumulation in confined excavations and below grade structures.

3.6 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of these natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

Commercially mineable coal seams will not be encountered and mining activities have not been identified at the Mainline A Regulator Facility project site. As such, CEC anticipates the there is a low risk of encountering arsenic bearing soils/rock during construction.

4.0 RECOMMENDATIONS

The following recommendations should be incorporated during construction to address geohazards within the proposed site LOD.

4.1 Oversight and Monitoring

4.1.1 Construction Oversight

The data collected and opinions presented in this report are based on CEC's review of published documents and the limited insight into the site surface and subsurface conditions that could be garnered during our desktop geohazard assessment. CEC recommends having geotechnical personnel on-site during construction in areas where geohazard mitigation measures are recommended. This allows a geotechnical engineer to evaluate the actual subsurface conditions encountered during construction, assess the appropriateness of the recommendations, modify recommendations when required, modify the locations of mitigation measures where required, and confirm CEC's recommendations are being correctly implemented.

5.0 POST-CONSTRUCTION MONITORING

CEC recommends that the areas described herein and additional areas of interest generated during construction are visually monitored by trained personnel under the supervision of a geotechnical engineer for signs of subsidence or instability. Field conditions related to landslides and karst geology induced subsidence features can evolve over long periods of time. CEC recommends

periodic monitoring of field conditions in areas where drainage causes water to pool. Periodic monitoring can be conducted concurrently with other asset inspections.

6.0 STANDARD OF CARE AND REPORT LIMITATIONS

This letter report was prepared for the purpose of design review. Reliance on this letter report by any party other than Transco, its authorized agents, or the PADEP is expressly forbidden. Contractors should not rely on the conclusions and interpretations in this letter report for purposes 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, subsurface conditions could differ at other locations.

7.0 CLOSING REMARKS

CEC appreciates this opportunity to be of service to Transco. Please call if you have any questions or comments.

Very truly yours,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Michael L. Schumaker, P.E. for:
Kuchanda Dy, P.E.
Assistant Project Manager

Michael L. Schumaker, P.E.
Principal

Attachment A – Important Information about This Geotechnical-Engineering Report
Attachment B – Figure

303-863.0101-LR-GEOT-10.9.20

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 not 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 Not 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 not 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 not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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

ATTACHMENT B

FIGURE

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

LEGEND

- PROPOSED LIMIT OF DISTURBANCE
- PROPOSED TEMPORARY WORKSPACE
- PROPOSED ACCESS ROAD
- EXISTING FACILITY FOOTPRINT
- COAL SURFACE MINE*
- DEEP MINED AREA*
- WETLAND
- STREAM
- INDEX CONTOUR - 10 FT
- INTERMEDIATE CONTOUR - 2 FT

ELEVATION GRADIENT

EL. 212 … EL. 22

NOTE(S)

1. * FEATURES NOT WITHIN DATA FRAME

REFERENCES

1. TOPOGRAPHY DERIVED FROM 2006 PA MAP PROGRAM LiDAR ELEVATION MODEL (DEM). TOPOGRAPHIC CONTOURS MAPPED AT A 2 FT INTERVAL.
2. WETLAND AND STREAM DATA OBTAINED FROM U.S. FISH AND WILDLIFE SERVICE NATIONAL WETLANDS INVENTORY (NWI) DATABASE FOR PENNSYLVAINA, 2016
3. FACILITY BOUNDARIES OBTAINED FROM WILLIAMS MIDSTREAM SERVICES, LLC TITLED "20201007 REA M&R PA Facilities.kmz" ON 10/07/2020.

Civil & Environmental Consultants, Inc.
333 Baldwin Road - Pittsburgh, PA 15205-9072
412-429-2324• 800-365-2324
www.cecinc.com

TRANSCONTINENTAL GAS PIPELINE COMPANY, LLC
REGIONAL ENERGY ACCESS FACILITIES
MAKEFIELD TOWNSHIP
BUCKS COUNTY, PENNSYLVANIA

MAINLINE A REGULATOR GEOHAZARD ASSESSMENT

DRAWN BY:	HCC	CHECKED BY:	KID	APPROVED BY: * Hand signature on file	MLS*
DATE:	10/8/2020	SCALE:	1 " = 200 '	PROJECT NO:	303-863

FIGURE NO: 1

P:\300-000\303-863\-GIS\Maps\303863_GT01_MAINLINE A REGULATOR.mxd 10/8/2020 8:37 AM (hchapella)

ATTACHMENT B-6
CARVERTON TIE-IN

September 8, 2020
(Revised October 9, 2020)

Ms. Michelle Mumme, P.E.
Transcontinental Gas Pipe Line Company, LLC
2800 Post Oak Blvd.
Houston, TX 77056

Dear Ms. Mumme:

Subject: Geotechnical Engineering Letter Report
Geohazard Assessment for the Carverton Tie-in West
Wyoming Borough, Luzerne County, Pennsylvania CEC
Project 303-863.0103

Civil & Environmental Consultants, Inc. (CEC) presents to Transcontinental Gas Pipe Line Company, LLC (Transco) the findings and recommendations associated with the subject project. CEC developed this revised report to summarize our literature review and to present generalized opinions and recommendations for implementing best management practices to address potential geohazards during construction. The report was revised to reflect project layout changes. Attachments to this report include Attachment A – "Important Information about Your Geotechnical Engineering Report" and Attachment B – Figure 1.

The following sections of this report include a discussion, data obtained, conclusions and recommendations, standard of care and report limitations, and closing remarks.

1.0 DISCUSSION

Transco is proposing to expand the existing Carverton Tie-in Facility in conjunction with the REA Facilities project. The Carverton Tie-in Facility is located in West Wyoming Borough, Luzerne County, Pennsylvania.

2.0 DATA OBTAINED

2.1 Desktop Literature Review

CEC conducted a desktop literature review to identify and evaluate potentially hazardous naturally occurring geologic formations and soil conditions (geohazards) that may be encountered along the project limits. The information reviewed was relative to soil types and geology, landslides, slope gradients, karst geology/sinkholes, radioactive or arsenic bearing formations, mining, and coal outcrops. CEC's purpose in reviewing these documents was to identify potential areas for further field study and, where appropriate, provide recommendations to reduce the risk of ground

movement or environmental impact due to naturally occurring geohazards during and after the new proposed construction.
CEC reviewed the following publically available information to identify potential geohazard areas that may be encountered along the project limits:

- United States Department of Agriculture (USDA), On-line Soil Survey Geographic Database for Luzerne County, Pennsylvania
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 59, "Glacial Deposits of Pennsylvania"
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 64, "Surficial Materials of Pennsylvania"
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 13, "Physiographic Provinces of Pennsylvania"
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 7, "Geologic Map of Pennsylvania"
- United States Geological Survey (USGS), Geologic Map of Pennsylvania - Map 1, dated 1980 (online)
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources, "Density of Mapped Karst Features in South-Central and Southeastern Pennsylvania"
- Commonwealth of Pennsylvania Department of Conservation and Natural Resources, "Pennsylvania Geologic Data Exploration (PaGEODE)" (web-mapping application)
- Commonwealth of Pennsylvania's Department of Conservation and Natural Resource's Mapping, "Landslides in Pennsylvania."
- Existing topographic contour information from PAMAP Program, Light Detection and Ranging (LiDAR) data, dated 2006.
- Department of Internal Affairs Topographic and Geologic Survey, "Map of the Coal Fields of Pennsylvania."
- Pennsylvania Department of Environment Protection (PADEP), Mine Subsidence Insurance Program, Check for Risk Application (Online)
- United States Environmental Protection Agency (USEPA), Map of Radon Zones (Online)
- USGS Open-File Report 2014–1082 "Geochemical and Mineralogical Maps for Soils of the Conterminous United States," dated 2014

Sections 2.2 through 2.8 present pertinent data obtained from the material referenced above for the Carverton Tie-in Facility permanent footprint and temporary workspace.

2.2 Soils

Within the proposed permanent footprint and temporary workspace for the Carverton Tie-in Facility referenced in Section 1.0, the soil survey for Luzerne County indicates soils consisting of loamy till (soil deposited by glaciers) is derived mainly from acid sandstone, siltstone, and shale. Reddish ablation till derived from sandstone and shale is also present. According to the Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map

64, "Surficial Materials of Pennsylvania", the near surface soils within the proposed limits of disturbance at the Carverton Tie-in Facility consist of sandy glacial diamict, described as having a moderate to abundant silt and sand matrix, along with minimal clay. The diamict overlies sandstone bedrock and has usually experienced minimal weathering, has thin soil development, and has suffered little erosion. Deposits of less than 3 feet are most common.

2.3 Landslide Mapping

According to the DCNR report title, "Landslides in Pennsylvania", the Carverton Tie-in Facility is not located in an area identified as being landslide susceptible. The area is categorized as a zone of low susceptibility for landslides except during times of heavy precipitation or after alteration of surface conditions by construction.

2.4 Topography

CEC performed a qualitative review of the topography within the proposed site limit of disturbance (LOD). This review was performed in conjunction with the review of the other desktop references pertaining to surficial and bedrock geology as discussed throughout this letter report. CEC considered, in a qualitative manner, the potential impact of standard pipeline construction practices on soil and rock strength. The actions of trenching and development of the construction right-of-way have the potential to create situations where relatively strong bedrock or stiff to hard residual soils that existed before construction are replaced with less competent backfill, when compared to undisturbed natural soil and bedrock, after construction. CEC also qualitatively considered how typical construction practices have the potential to influence groundwater flow patterns, such as by potentially concentrating groundwater flow in pipe trenches, in construction and post-construction conditions.

According to topographic mapping, the site generally consists of steep terrain (up to approximately 2H:1V) that slopes down toward the northeast. Several coves and/or drainage features are present within the proposed right-of-way alignment.

2.5 Bedrock Geology

2.5.1 Stratigraphy

Stratigraphic rock units present at or near the surface within the proposed site limit of disturbance (LOD) belong to the Mississippian aged, Mauch Chunk Formation. The Mauch Chunk Formation consists grayish-red shale, and siltstone, brown, gray, and white sandstone, and some conglomerate.

2.5.2 Karst Topography

CEC reviewed DCNR mapping to identify the presence of soluble limestone and karst geologic features indicative of limestone solution. According to reviewed mapping, the site is not located

in an area with carbonate rock at the ground surface, and there are no documented sinkholes or surface depressions in Luzerne County, PA, where the Carverton Tie-in Facility is located.

2.6 Mining and Coal Conditions

2.6.1 Surface and Deep Mining

According to the resources listed above, commercially mined coal seams will not be encountered at the site and surface or deep-mining activities have not occurred within the LOD.

2.6.2 Acid Producing Rock

Bedrock excavated as part of mining activities commonly possesses characteristics of APR. However as discussed, the proposed LOD is not located in an area that has been previously strip mined and/or deep-mined. Therefore, the need to manage APR during construction activities is not anticipated.

2.7 Radioactive Soils/Bedrock

Common sources of radioactivity in soil and rock include uranium-bearing minerals and oxides formed through the action of weathering. The largest concentrations of uranium-bearing minerals occur in organic rich black shales, ultramafic igneous rocks, and soils derived from these sources. Of these potential sources, only shales and shale derived soils are present in the facility's LOD. The shale units present in the project area are typically not organic rich in nature.

The most common geologic hazard associated with radioactive soils and rock is the occurrence of radon, a naturally occurring daughter product that occurs as an intermediate step in the normal radioactive decay of uranium. Radon is a colorless, odorless gas that can cause health effects due to the release of alpha particles, especially when allowed to accumulate in enclosed spaces. According to the United States Environmental Protection Agency (USEPA) Map of Radon Zones, the facilities current location is at an elevated potential risk for radon in indoor air. Radon accumulation in outdoor work areas such as pipe trenches and excavations is not anticipated.

2.8 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of these natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

No mining activities have been identified within the LOD. It is unlikely that coal bearing rock stratum will be encountered during construction. If encountered, coal and coal associated units will likely be weathered and excavation activities are not expected to generate appreciable amounts of material with potentially elevated arsenic.

3.0 CONCLUSIONS AND RECOMMENDATIONS

CEC notes that the opinions presented herein are based on CEC's review of published documents and reliable web resources. CEC recommends that field conditions be observed by a field representative under the direction of a professional geotechnical engineer during construction to determine if new geohazards have manifested, verify the opinions presented herein, and provide additional recommendations as needed. Based on the conclusions presented, CEC anticipates limited geohazard mitigation measures may need to be incorporated in site development plans and/or pending inspection of field conditions under the direction of a professional geotechnical engineer during construction.

3.1 Surficial Geology and Groundwater

Based on CEC's research of historic landslide activity as well as landslide susceptible areas at the site, CEC concludes that the facility expansion construction will not occur in landslide susceptible soils.

Surface water best management practices should be implemented according to the erosion and sedimentation control plans for controlling soil erosion thereby reducing the risk of slope or excavation instability. Site development design plans should specify that new embankments be constructed as compacted fills and incorporate toe keys and drainage measures to provide long-term slope stability.

3.2 Karst Topography

CEC reviewed USGS geologic descriptions of the site bedrock formations and available mapping of known karst bedrock, and concluded that the risk of karst feature development in the site soil and bedrock units is low.

3.3 Mining

According to the references reviewed, commercially mined coal seams will not be encountered at the site and surface or deep-mining activities have not occurred within the LOD. CEC concludes that there is no risk of subsidence occurring.

3.4 Acid Producing Rock

CEC does not does not anticipate that coal or APR will be encountered during construction. However, if coal or other APR is encountered in sufficient concentrations, it can be mitigated in accordance with PADEP guidelines. If potentially APR is encountered in excavated shale the contractor should immediately notify Transco. Such materials should be handled in accordance with Pennsylvania Department of Environment Protection (PADEP) document No. 5600-FS-DEP4284, "How to Avoid and Handle Acid-Producing Rock Formations Encountered during Well Site Development".

3.5 Radioactive Soils/Bedrock

CEC reviewed information regarding radioactive soils and bedrock at the site, and anticipates that it is unlikely that the soils and rock present within the facility LOD contain elevated levels of radioactivity. The proposed construction activities are not anticipated to result in potential accumulation of radon gas, the most common hazard associated with naturally occurring radioactive decay. CEC recommends that construction safety protocols consider radon accumulation in confined excavations and below grade structures.

3.6 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of these natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

Commercially mineable coal seams will not be encountered and mining activities have not been identified at the proposed project site. As such, CEC anticipates that there is a low risk of encountering arsenic bearing soils/rock during construction.

4.0 RECOMMENDATIONS

The following recommendations should be incorporated during construction to address geohazards within the proposed site LOD.

4.1 Oversight and Monitoring

4.1.1 Construction Oversight

The data collected and opinions presented in this report are based on CEC's review of published documents and the limited insight into the site surface and subsurface conditions that could be garnered during our desktop geohazard assessment. CEC recommends having geotechnical personnel on-site during construction in areas where geohazard mitigation measures are recommended. This allows a geotechnical engineer to evaluate the actual subsurface conditions encountered during construction, assess the appropriateness of the recommendations, modify recommendations when required, modify the locations of mitigation measures where required, and confirm CEC's recommendations are being correctly implemented.

5.0 POST-CONSTRUCTION MONITORING

CEC recommends that the areas described herein and additional areas of interest generated during construction are visually monitored by trained personnel under the supervision of a geotechnical engineer for signs of subsidence or instability. Field conditions related to landslides can evolve over long periods of time. CEC recommends periodic monitoring of field conditions in areas

where drainage causes water to pool. Periodic monitoring can be conducted concurrently with other asset inspections.

6.0 STANDARD OF CARE AND REPORT LIMITATIONS

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7.0 CLOSING REMARKS

CEC appreciates this opportunity to be of service to Transco. Please call if you have any questions or comments.

Very truly yours,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Michael L. Schumaker, P.E. for:
Kuchanda Dy, P.E.
Assistant Project Manager

Michael L. Schumaker, P.E.
Principal

Attachment A – Important Information about This Geotechnical-Engineering Report
Attachment B – Figure

303-863.0103-LR-GEOT-09-8.20

ATTACHMENT A

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Important Information about This

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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.

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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

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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.

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- 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
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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.

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- 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 Not 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 not 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 not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

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

ATTACHMENT B

FIGURE

NORTH

EXISTING ACCESS ROAD

EXISTING FACILITY FOOTPRINT

Nedbridge Ln

Nowicki Ln

SCALE IN FEET
0 200 400

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

LEGEND

- PROPOSED LIMIT OF DISTURBANCE
- PROPOSED CARVERTON TIE-IN
- PROPOSED ACCESS ROAD
- PROPOSED TEMPORARY WORKSPACE
- PROPOSED ADDITIONAL TEMPORARY WORKSPACE
- PROPOSED PIPELINE ALIGNMENT
- EXISTING FACILITY FOOTPRINT
- EXISTING ACCESS ROAD
- DEEP MINED AREA*
- SURFACE MINED AREA*
- WETLAND
- STREAM
- INDEX CONTOUR - 10 FT
- INTERMEDIATE CONTOUR - 2 FT

ELEVATION GRADIENT
EL. 1640
EL. 534

NOTE(S)

1. * FEATURES ARE NOT WITHIN DATA FRAME

REFERENCE(S)

1. TOPOGRAPHY DERIVED FROM 2008 PA MAP PROGRAM DIGITAL ELEVATION MODEL (DEM). TOPOGRAPHIC CONTOURS MAPPED AT A 2 FT INTERVAL.
3. WETLAND AND STREAM DATA OBTAINED FROM U.S. FISH AND WILDLIFE SERVICE NATIONAL WETLANDS INVENTORY (NWI) DATABASE FOR PENNSYLVANIA, 2016 AND ENHANCED WITH SURVEYED DELINEATIONS FOR TRANSCONTINENTAL GAS PIPELINE COMPANY, LLC IN 2019.
4. FACILITY BOUNDARIES OBTAINED FROM WILLIAMS MIDSTREAM SERVICES, LLC TITLED "20201007 REA M&R PA Facilities.kmz" ON 10/07/2020.

Civil & Environmental Consultants, Inc.
333 Baldwin Road - Pittsburgh, PA 15205-9072
412-429-2324• 800-365-2324
www.cecinc.com

TRANSCONTINENTAL GAS PIPELINE COMPANY, LLC
REGIONAL ENERGY ACCESS FACILITIES
WEST WYOMING BORO
LUZERNE COUNTY, PENNSYLVANIA

CARVERTON TIE-IN GEOHAZARD ASSESSMENT

DRAWN BY:	HCC	CHECKED BY:	KID	APPROVED BY:	* Hand signature on file MLS	FIGURE NO:	1
DATE:	10/8/2020	SCALE:	1 " = 200 '	PROJECT NO:	303-863		

P:\300-000\303-863\-GIS\Maps\303863_GT01_CARVERTON MR FACILITIES.mxd 10/8/2020 7:48 AM (hchapella)

ATTACHMENT B-7
HILDEBRANDT TIE-IN/MLV-515RA40

September 8, 2020
(Revised October 9, 2020)

Ms. Michelle Mumme, P.E.
Transcontinental Gas Pipe Line Company, LLC
2800 Post Oak Blvd.
Houston, TX 77056

Dear Ms. Mumme:

Subject: Geotechnical Engineering Letter Report
Geohazard Assessment for the Hildebrandt Tie-In

Dallas Township, Luzerne County, Pennsylvania
CEC Project 303-863.0104

Civil & Environmental Consultants, Inc. (CEC) presents to Transcontinental Gas Pipe Line Company, LLC (Transco) the findings and recommendations associated with the subject project. CEC developed this revised report to summarize our literature review and to present generalized opinions and recommendations for implementing best management practices to address potential geohazards during construction. The report was revised to reflect project layout changes. Attachments to this report include Attachment A – "Important Information about Your Geotechnical Engineering Report" and Attachment B – Figure 1.

The following sections of this report include a discussion, data obtained, conclusions and recommendations, standard of care and report limitations, and closing remarks.

1.0 DISCUSSION

Transco is proposing an expansion of the existing Hildebrandt Meter & Regulating (M&R) Facility in conjunction with the REA facilities project. The Hildebrandt Tie-In Expansion construction is located in Dallas Township, Luzerne County, Pennsylvania.

2.0 DATA OBTAINED

2.1 Desktop Literature Review

CEC conducted a desktop literature review to identify and evaluate potentially hazardous naturally occurring geologic formations and soil conditions (geohazards) that may be encountered along the project limits. The information reviewed was relative to soil types and geology, landslides, slope gradients, karst geology/sinkholes, radioactive or arsenic bearing formations, mining, and coal outcrops. CEC's purpose in reviewing these documents was to identify potential areas for further field study and, where appropriate, provide recommendations to reduce the risk of ground

movement or environmental impact due to naturally occurring geohazards during and after the new proposed construction.
CEC reviewed the following publically available information to identify potential geohazard areas that may be encountered along the project limits:

- Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 59, "Glacial Deposits of Pennsylvania."
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 64, "Surficial Materials of Pennsylvania."
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 13, "Physiographic Provinces of Pennsylvania."
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 7, "Geologic Map of Pennsylvania."
- United States Geological Survey (USGS), Geologic Map of Pennsylvania - Map 1, dated 1980.
- Commonwealth of Pennsylvania Department of Conservation and Natural Resources, "Pennsylvania Geologic Data Exploration (PaGEODE)" (web-mapping application) accessed 8/19/20.
- Pennsylvania Geological Society publication "Landslides in Pennsylvania."
- Existing topographic contour information from PAMAP Program, Light Detection and Ranging (LiDAR) data, dated 2006.
- U.S. Department of Agriculture, National Resources Conservation Service, Custom Soil Resource Report for Luzerne County, Pennsylvania, prepared on 8/19/20 on the Web Soil Survey website. http://websoilsurvey.nrcs.usda.gov
- Pennsylvania Mine maps Atlas, The Pennsylvania State University. Accessed 8/19/2020. www.minemaps.psu.edu
- Commonwealth of Pennsylvania Department of Conservation and Natural Resources Bureau of Topographic and Geologic Survey, "Distribution of Pennsylvania Coals." Map 11. Third Edition, Revised, 2000.
- Pennsylvania Department of Environment Protection (PADEP), Mine Subsidence Insurance Program, Check for Risk Application (Online) accessed 8/19/20.
- United States Environmental Protection Agency (USEPA), Map of Radon Zones (Online).
- USGS Open-File Report 2014–1082 "Geochemical and Mineralogical Maps for Soils of the Conterminous United States," dated 2014.

Sections 2.2 through 2.8 present pertinent data obtained from the material referenced above for the permanent footprint and temporary workspace of the Hildebrandt Tie-In Expansion.

2.2 Soils

Within the proposed permanent footprint and temporary workspace of the Hildebrandt Tie-In Expansion Facility referenced in Section 1.0, the soil survey for Luzerne County indicates soils consisting of loamy till (soil deposited by glaciers) derived mainly from sandstone, siltstone, and

shale. According to the Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 64, "Surficial Materials of Pennsylvania", the near surface soils within the proposed limits of disturbance at the proposed facility consists of sandy glacial diamict, described as having a moderate to abundant silt and sand matrix, along with minimal clay. The diamict overlies sandstone bedrock and has usually experienced minimal weathering, has thin soil development, and has suffered little erosion. Deposits of less than 3 feet are most common.

2.3 Landslide Mapping

According to the DCNR report titled, "Landslides in Pennsylvania", the Hildebrandt Tie-In Expansion site location is not within an area categorized as landslide susceptible. The area is categorized as a zone of low susceptibility for landslides except during times of heavy precipitation or after alteration of surface conditions by construction.

2.4 Topography

CEC performed a qualitative review of the topography within the proposed site limit of disturbance (LOD). This review was performed in conjunction with the review of the other desktop references pertaining to surficial and bedrock geology as discussed throughout this letter report. CEC considered, in a qualitative manner, the potential impact of standard pipeline construction practices on soil and rock strength. The actions of trenching and development of the construction right-of-way have the potential to create situations where relatively strong bedrock or stiff to hard residual soils that existed before construction are replaced with less competent backfill, when compared to undisturbed natural soil and bedrock, after construction. CEC also qualitatively considered how typical construction practices have the potential to influence groundwater flow patterns, such as by potentially concentrating groundwater flow in pipe trenches, in construction and post-construction conditions. According to topographic mapping, the site generally consists of nearly level terrain, gently sloping to the west, with elevations ranging from 1286 to 1276. Drainage features/tributaries are present south of the proposed LOD.

2.5 Bedrock Geology

2.5.1 Stratigraphy

Stratigraphic rock units present at or near the surface within the proposed site limit of disturbance (LOD) belong to the Devonian aged, Catskill Formation. The Catskill Formation consists of grayish-red sandstone, siltstone, shale, and mudstone; with units of gray sandstone occurring in the upper portions. Lithology in the upper portions are arranged in fining-upward cycles.

2.5.2 Karst Topography

CEC reviewed DCNR mapping to identify the presence of soluble limestone and karst geologic features indicative of limestone solution. According to the reviewed mapping, the site is located

in an area absent of carbonate rock at the surface. There are no documented sinkholes or surface depressions near the Hildebrandt Tie-In Expansion site location in Luzerne County, PA

2.6 Mining and Coal Conditions

2.6.1 Surface and Deep Mining

According to the resources listed above, commercially mined coal seams will not be encountered at the site and surface or deep-mining activities have not occurred within the LOD.

2.6.2 Acid Producing Rock

Bedrock excavated as part of mining activities commonly possesses characteristics of APR. However, as discussed the proposed LOD is not located in an area that has been previously strip mined and/or deep-mined. Therefore, the need to manage APR during construction activities is not anticipated.

2.7 Radioactive Soils/Bedrock

Common sources of radioactivity in soil and rock include uranium-bearing minerals and oxides formed through the action of weathering. The largest concentrations of uranium-bearing minerals occur in organic rich black shales, ultramafic igneous rocks, and soils derived from these sources. It is unlikely that a potential source of radioactive soil/bedrock is present near the LOD.

The most common geologic hazard associated with radioactive soils and rock is the occurrence of radon, a naturally occurring daughter product that occurs as an intermediate step in the normal radioactive decay of uranium. Radon is a colorless, odorless gas that can cause health effects due to the release of alpha particles, especially when allowed to accumulate in enclosed spaces. According to the United States Environmental Protection Agency (USEPA) Map of Radon Zones, the meter station location is at an elevated potential risk for radon in indoor air. Radon accumulation in outdoor work areas such as pipe trenches and excavations is not anticipated.

2.8 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of these natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

No mining activities have been identified within the LOD of the Hildebrandt Tie-In Expansion site. It is unlikely that coal bearing rock stratum will be encountered during construction. If encountered, coal and coal associated units will likely be weathered and excavation are not anticipated to generate appreciable amounts of material with potentially elevated arsenic.

3.0 CONCLUSIONS AND RECOMMENDATIONS

CEC notes that the opinions presented herein are based on CEC's review of published documents and reliable web resources. CEC recommends that field conditions be observed by a field representative under the direction of a professional geotechnical engineer during construction to determine if new geohazards have manifested, verify the opinions presented herein, and provide additional recommendations as needed. Based on the conclusions presented, CEC anticipates the following limited geohazard mitigation measures may need to be incorporated in site development plans and/or be necessary, pending inspection of field conditions under the direction of a professional geotechnical engineer during construction.

3.1 Soils and Ground Water

Based on CEC's research of historic landslide activity as well as landslide susceptible areas at the site, CEC concludes that the Hildebrandt Tie-In Expansion Facility construction will not occur in landslide susceptible soils.

Surface water best management practices should be implemented according to the erosion and sedimentation control plans for controlling soil erosion thereby reducing the risk of slope or excavation instability. Site development design plans should specify that new embankments be constructed as compacted fills and incorporate toe keys and drainage measures to provide long-term slope stability.

3.2 Karst Topography

CEC reviewed USGS geologic descriptions of the site bedrock formations and available mapping of known karst bedrock, and determined that the risk for karst formations in the site soil and bedrock units is low. This based on the lack of geologic features indicative of karst topography on the mapping reviewed.

3.3 Mining

According to the references reviewed, commercially mined coal seams will not be encountered at the site and surface or deep-mining activities have not occurred within the LOD. CEC concludes that there is little to no risk of subsidence occurring

3.4 Acid Producing Rock

CEC does not does not anticipate that coal or APR will be encountered during construction. However, if coal or other APR is encountered in sufficient concentrations, it can be mitigated in accordance with PADEP guidelines. If potentially APR is encountered in excavated shale the contractor should immediately notify Transco. Such materials should be handled in accordance with Pennsylvania Department of Environment Protection (PADEP) document No. 5600-FS-

DEP4284, "How to Avoid and Handle Acid-Producing Rock Formations Encountered during Well Site Development".

3.5 Radioactive Soils/Bedrock

Based on the information reviewed regarding radioactive soils and bedrock at the site, CEC anticipates that it is unlikely that the soils and rock present within the proposed LOD contain elevated levels of radioactivity. The proposed construction activities are not anticipated to result in potential accumulation of radon gas, the most common hazard associated with naturally occurring radioactive decay. CEC recommends that construction safety protocols consider radon accumulation in confined excavations and below grade structures.

3.6 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of these natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

Commercially mineable coal seams will not be encountered and mining activities have not been identified at the Hildebrandt Tie-In Expansion project site. As such, CEC anticipates the there is a low risk of encountering arsenic bearing soils/rock during construction.

4.0 RECOMMENDATIONS

The following recommendations should be incorporated during construction to address geohazards within the proposed site LOD. Oversight and Monitoring

4.1 Oversight and Monitoring

4.1.1 Construction Oversight

The data collected and opinions presented in this report are based on CEC's review of published documents and the limited insight into the site surface and subsurface conditions that could be garnered during our desktop geohazard assessment. CEC recommends having geotechnical personnel on-site during construction in areas where geohazard mitigation measures are recommended. This allows a geotechnical engineer to evaluate the actual subsurface conditions encountered during construction, assess the appropriateness of the recommendations, modify recommendations when required, modify the locations of mitigation measures where required, and confirm CEC's recommendations are being correctly implemented.

5.0 POST-CONSTRUCTION MONITORING

CEC recommends that the areas described herein and additional areas of interest generated during construction are visually monitored by trained personnel under the supervision of a geotechnical engineer for signs of subsidence or instability. Field conditions related to landslides and karst geology induced subsidence features can evolve over long periods of time. CEC recommends periodic monitoring of field conditions in areas where drainage causes water to pool. Periodic monitoring can be conducted concurrently with other asset inspections.

6.0 STANDARD OF CARE AND REPORT LIMITATIONS

This letter report was prepared for the purpose of design review. Reliance on this letter report by any party other than Transco, its authorized agents, or PADEP is expressly forbidden. Contractors should not rely on the conclusions and interpretations in this letter report for purposes 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 this opportunity to be of service to Transco. Please call if you have any questions or comments.

Very truly yours,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Michael L. Schumaker, P.E. for:
Kuchanda Dy, P.E.
Assistant Project Manager

Michael L. Schumaker, P.E.
Principal

Attachment A – Important Information about This Geotechnical-Engineering Report
Attachment B – Figure 1

303-863.0104-LR-GEOT-10.9.20

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.

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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 Not 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 not 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 not building-envelope or mold specialists.***

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ATTACHMENT B

FIGURE

NORTH

EXISTING ACCESS ROAD

EXISTING FACILITY FOOTPRINT (TYP.)

1330
1320
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1290
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SCALE IN FEET
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COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

LEGEND

- PROPOSED HILDEBRANDT TIE-IN EXPANSION
- PROPOSED LIMIT OF DISTURBANCE
- PROPOSED TEMPORARY WORKSPACE
- PROPOSED ACCESS ROAD
- PROPOSED PIPELINE ALIGNMENT
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NOTE(S)

1. * FEATURES ARE NOT WITHIN DATA FRAME

REFERENCE(S)

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3. FACILITY BOUNDARIES OBTAINED FROM WILLIAMS MIDSTREAM SERVICES, LLC TITLED "20201007 REA M&R PA Facilities.kmz" ON 10/07/2020.

Civil & Environmental Consultants, Inc.
333 Baldwin Road - Pittsburgh, PA 15205-9072
412-429-2324• 800-365-2324
www.cecinc.com

TRANSCONTINENTAL GAS PIPELINE COMPANY, LLC
REGIONAL ENERGY ACCESS FACILITIES
DALLAS TOWNSHIP
LUZERNE COUNTY, PENNSYLVANIA

HILDEBRANDT TIE-IN
GEOHAZARD ASSESSMENT

DRAWN BY:	HCC	CHECKED BY:	KID	APPROVED BY:	* Hand signature on file MLS*
DATE:	10/8/2020	SCALE:	1 " = 200 '	PROJECT NO:	303-863

FIGURE NO: 1

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ATTACHMENT B-8
LOWER DEMUNDS REL TIE-IN

September 8, 2020
(Revised October 9, 2020)

Ms. Michelle Mumme, P.E.
Transcontinental Gas Pipe Line Company, LLC
2800 Post Oak Blvd.
Houston, TX 77056

Dear Ms. Mumme:

Subject: Geotechnical Engineering Letter Report
Geohazard Assessment for Lower Demunds REL Tie-In
Dallas Township, Luzerne County, Pennsylvania
CEC Project 303-863.0105

Civil & Environmental Consultants, Inc. (CEC) presents to Transcontinental Gas Pipe Line Company, LLC (Transco) the findings and recommendations associated with the subject project. CEC developed this revised report to summarize our literature review and to present generalized opinions and recommendations for implementing best management practices to address potential geohazards during construction. The report was revised to include figures with updates to the project layout. Attachments to this report include Attachment A – "Important Information about Your Geotechnical Engineering Report" and Attachment B – Figure 1.

The following sections of this report include a discussion, data obtained, conclusions and recommendations, standard of care and report limitations, and closing remarks.

1.0 DISCUSSION

Transco is proposing a new 20" x 20" tee to valve PL358 to Leidy and a 16" pipe connection from the new tee to the REL pipeline, designated as the Lower Demunds REL Tie-In. The proposed construction is located in Dallas Township, Luzerne County, Pennsylvania.

2.0 DATA OBTAINED

2.1 Desktop Literature Review

CEC conducted a desktop literature review to identify and evaluate potentially hazardous naturally occurring geologic formations and soil conditions (geohazards) that may be encountered during the project limits. The information reviewed was relative to soil types, geology, landslides, slope gradients, karst geology/sinkholes, radioactive or arsenic bearing formations, mining, and coal outcrops. CEC's purpose in reviewing these documents was to identify potential areas for further field study and, where appropriate, provide recommendations to reduce the risk of ground movement or environmental impact due to naturally occurring geohazards during and after the new proposed construction.

CEC reviewed the following publically available information to identify potential geohazard areas that may be encountered along the project limits:

- Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 59, "Glacial Deposits of Pennsylvania."
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 64, "Surficial Materials of Pennsylvania."
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 13, "Physiographic Provinces of Pennsylvania."
- Commonwealth of Pennsylvania Department of Conservation of Natural Resources Map 7, "Geologic Map of Pennsylvania."
- United States Geological Survey (USGS), Geologic Map of Pennsylvania - Map 1, dated 1980.
- Commonwealth of Pennsylvania Department of Conservation and Natural Resources, "Pennsylvania Geologic Data Exploration (PaGEODE)" (web-mapping application) accessed 8/19/20.
- Pennsylvania Geological Society publication "Landslides in Pennsylvania."
- Existing topographic contour information from PAMAP Program, Light Detection and Ranging (LiDAR) data, dated 2006.
- U.S. Department of Agriculture, National Resources Conservation Service, Custom Soil Resource Report for Luzerne County, Pennsylvania, prepared on 8/19/20 on the Web Soil Survey website. http://websoilsurvey.nrcs.usda.gov
- Pennsylvania Mine maps Atlas, The Pennsylvania State University. Accessed 8/19/2020. www.minemaps.psu.edu
- Commonwealth of Pennsylvania Department of Conservation and Natural Resources Bureau of Topographic and Geologic Survey, "Distribution of Pennsylvania Coals." Map 11. Third Edition, Revised, 2000.
- Pennsylvania Department of Environment Protection (PADEP), Mine Subsidence Insurance Program, Check for Risk Application (Online) accessed 8/19/20.
- United States Environmental Protection Agency (USEPA), Map of Radon Zones (Online).
- USGS Open-File Report 2014–1082 "Geochemical and Mineralogical Maps for Soils of the Conterminous United States," dated 2014.

Sections 2.2 through 2.8 present pertinent data obtained from the material referenced above for the Lower Demunds REL Tie-In permanent footprint and temporary workspace.

2.2 Soils

Within the proposed permanent footprint and temporary workspace referenced in Section 1.0, the soil survey for Luzerne County indicates soils consisting of loamy till (soil deposited by glaciers) derived mainly from sandstone, siltstone, and shale. According to the Commonwealth of Pennsylvania Department of Conservation of Natural Resources (DCNR) Map 64, "Surficial Materials of Pennsylvania", the near surface soils within the proposed limits of disturbance

consists of sandy glacial diamict, described as having a moderate to abundant silt and sand matrix, along with minimal clay. The diamict overlies sandstone bedrock and has usually experienced minimal weathering, has thin soil development, and has suffered little erosion. Deposits of less than 3 feet are most common.

2.3 Landslide Mapping

According to the DCNR report titled, "Landslides in Pennsylvania", the proposed site location is not located within an area identified as being landslide susceptible. The area is categorized as a zone of low susceptibility for landslides except during times of heavy precipitation or after alteration of surface conditions by construction.

2.4 Topography

CEC performed a qualitative review of the topography within the proposed site limit of disturbance (LOD). This review was performed in conjunction with the review of the other desktop references pertaining to surficial and bedrock geology as discussed throughout this letter report. CEC considered, in a qualitative manner, the potential impact of standard pipeline construction practices on soil and rock strength. The actions of trenching and development of the construction right-of-way have the potential to create situations where relatively strong bedrock or stiff to hard residual soils that existed before construction are replaced with less competent backfill, when compared to undisturbed natural soil and bedrock, after construction. CEC also qualitatively considered how typical construction practices have the potential to influence groundwater flow patterns, such as by potentially concentrating groundwater flow in pipe trenches, in construction and post-construction conditions.

According to topographic mapping, the site generally consists of nearly level terrain. Steep slopes and drainage features/tributaries are present southeast of the proposed LOD.

2.5 Bedrock Geology

2.5.1 Stratigraphy

Stratigraphic rock units present at or near the surface within the proposed site limit of disturbance (LOD) belong to the Devonian aged, Catskill Formation. The Catskill Formation consists of grayish-red sandstone, siltstone, shale, and mudstone; with units of gray sandstone occurring in the upper portions. Lithology in the upper portions are arranged in fining-upward cycles.

2.5.2 Karst Topography

CEC reviewed DCNR mapping to identify the presence of soluble limestone and karst geologic features indicative of limestone solution. According to the reviewed mapping, there are no documented sinkholes or surface depressions in Luzerne County, PA, where the proposed LOD is located.

2.6 Mining and Coal Conditions

2.6.1 Surface and Deep Mining

According to the resources listed above, commercially mined coal seams will not be encountered at the site and surface or deep-mining activities have not occurred within the LOD.

2.6.2 Acid Producing Rock

Bedrock excavated as part of mining activities commonly possesses characteristics of APR. However, as discussed the proposed LOD is not located in an area that has been previously strip mined and/or deep-mined. Therefore, the need to manage APR during construction activities is not anticipated.

2.7 Radioactive Soils/Bedrock

Common sources of radioactivity in soil and rock include uranium-bearing minerals and oxides formed through the action of weathering. The largest concentrations of uranium-bearing minerals occur in organic rich black shales, ultramafic igneous rocks, and soils derived from these sources. Of these potential sources, only shales and shale derived soils are present within the proposed LOD. The shale units present in the project area are typically not organic rich in nature.

The most common geologic hazard associated with radioactive soils and rock is the occurrence of radon, a naturally occurring daughter product that occurs as an intermediate step in the normal radioactive decay of uranium. Radon is a colorless, odorless gas that can cause health effects due to the release of alpha particles, especially when allowed to accumulate in enclosed spaces. According to the United States Environmental Protection Agency (USEPA) Map of Radon Zones, the proposed site is at an elevated potential risk for radon in indoor air. Radon accumulation in outdoor work areas such as pipe trenches and excavations is not anticipated.

2.8 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of these natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

No mining activities have been identified within the proposed LOD. It is unlikely that coal bearing rock stratum will be encountered during construction. If encountered, coal and coal associated units will likely be weathered and excavation are not anticipated to generate appreciable amounts of material with potentially elevated arsenic.

3.0 CONCLUSIONS AND RECOMMENDATIONS

CEC notes that the opinions presented herein are based on CEC's review of published documents and reliable web resources. CEC recommends that field conditions be observed by a field representative under the direction of a professional geotechnical engineer during construction to determine if new geohazards have manifested, to verify the opinions presented herein, and provide additional recommendations as needed. Based on the conclusions presented, CEC anticipates the following limited geohazard mitigation measures may need to be incorporated in site development plans and/or be necessary, pending inspection of field conditions under the direction of a professional geotechnical engineer during construction.

3.1 Soils and Ground Water

Based on CEC's research of historic landslide activity as well as landslide susceptible areas at the site, CEC concludes that the proposed construction will not occur in landslide susceptible soils.

Surface water best management practices should be implemented according to the erosion and sedimentation control plans for controlling soil erosion thereby reducing the risk of slope or excavation instability. Site development design plans should specify that new embankments be constructed as compacted fills and incorporate toe keys and drainage measures to provide long-term slope stability.

3.2 Karst Topography

CEC reviewed USGS geologic descriptions of the site bedrock formations and available mapping of known karst bedrock, and concluded that the risk of karst feature development in the site soil and bedrock units is low. This is based on the lack of geologic features indicative of karst topography on the mapping reviewed.

3.3 Mining

According to the references reviewed, commercially mined coal seams will not be encountered at the site and surface or deep-mining activities have not occurred within the LOD. CEC concludes that there is little to no risk of subsidence occurring.

3.4 Acid Producing Rock

CEC does not does not anticipate that coal or APR will be encountered during construction. However, if coal or other APR is encountered in sufficient concentrations, it can be mitigated in accordance with PADEP guidelines. If potentially APR is encountered in excavated shale the contractor should immediately notify Transco. Such materials should be handled in accordance with Pennsylvania Department of Environment Protection (PADEP) document No. 5600-FS-DEP4284, "How to Avoid and Handle Acid-Producing Rock Formations Encountered during Well Site Development".

3.5 Radioactive Soils/Bedrock

CEC reviewed information regarding radioactive soils and bedrock at the site, CEC anticipates that it is unlikely that the soils and rock present within the proposed LOD contain elevated levels of radioactivity. The proposed construction activities are not anticipated to result in potential accumulation of radon gas, the most common hazard associated with naturally occurring radioactive decay. CEC recommends that construction safety protocols consider radon accumulation in confined excavations and below grade structures.

3.6 Arsenic Bearing Soils/Bedrock

Arsenic occurs naturally in soil and rocks in Pennsylvania. Arsenic concentrations in excess of these natural background levels can occur in pyritic rock and soil, which are often associated with black shales, coal, and coal mine spoils. The higher arsenic concentrations in these materials reflect the larger proportion of sulfide minerals, oxides, organic matter, and clays.

Commercially mineable coal seams will not be encountered and mining activities have not been identified at the proposed compressor station project site. As such, CEC anticipates the there is a low risk of encountering arsenic bearing soils/rock during construction.

4.0 RECOMMENDATIONS

The following recommendations should be incorporated during construction to address geohazards within the proposed site LOD.

4.1 Oversight and Monitoring

4.1.1 Construction Oversight

The data collected and opinions presented in this report are based on CEC's review of published documents and the limited insight into the site surface and subsurface conditions that could be garnered during our desktop geohazard assessment. CEC recommends having geotechnical personnel on-site during construction in areas where geohazard mitigation measures are recommended. This allows a geotechnical engineer to evaluate the actual subsurface conditions encountered during construction, assess the appropriateness of the recommendations, modify recommendations when required, modify the locations of mitigation measures where required, and confirm CEC's recommendations are being correctly implemented.

5.0 POST-CONSTRUCTION MONITORING

CEC recommends that the areas described herein and additional areas of interest generated during construction are visually monitored by trained personnel under the supervision of a geotechnical engineer for signs of subsidence or instability. Field conditions related to landslides and karst geology induced subsidence features can evolve over long periods of time. CEC recommends

periodic monitoring of field conditions in areas where drainage causes water to pool. Periodic monitoring can be conducted concurrently with other asset inspections.

6.0 STANDARD OF CARE AND REPORT LIMITATIONS

This letter report was prepared for the purpose of design review. Reliance on this letter report by any party other than Transco, its authorized agents, or PADEP is expressly forbidden. Contractors should not rely on the conclusions and interpretations in this letter report for purposes 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 this opportunity to be of service to Transco. Please call if you have any questions or comments.

Very truly yours,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.

Michael L. Schumaker, P.E.
Kuchanda Dy, P.E.
Assistant Project Manager

Michael L. Schumaker, P.E.
Principal

Attachment A – Important Information about This Geotechnical-Engineering Report
Attachment B – Figure 1

303-863.0105-LR-GEOT-10.9.20

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 not 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.

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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 not 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 not building-envelope or mold specialists.***

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COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
MICHAEL L. SCHUMAKER
ENGINEER
PE-054221-E

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1. TOPOGRAPHY DERIVED FROM 2008 PA MAP PROGRAM LIDAR DIGITAL ELEVATION MODEL (DEM). TOPOGRAPHIC CONTOURS MAPPED AT A 2 FT INTERVAL.
2. WETLAND AND STREAM DATA OBTAINED FROM U.S. FISH AND WILDLIFE SERVICE NATIONAL WETLANDS INVENTORY (NWI) DATABASE FOR PENNSYLVANIA, 2016 AND ENHANCED WITH SURVEYED DELINEATIONS FOR TRANSCONTINENTAL GAS PIPELINE COMPANY, LLC IN 2019.
3. FACILITY BOUNDARIES OBTAINED FROM WILLIAMS MIDSTREAM SERVICES, LLC TITLED "20201007 REA M&R PA Facilities.kmz" ON 10/07/2020.

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TRANSCONTINENTAL GAS PIPELINE COMPANY, LLC
REGIONAL ENERGY ACCESS FACILITIES
DALLAS TOWNSHIP
LUZERNE COUNTY, PENNSYLVANIA

LOWER DEMUNDS REL TIE-IN GEOHAZARD ASSESSMENT

DRAWN BY:	HCC	CHECKED BY:	KID	APPROVED BY: * Hand signature on file MLS*	FIGURE NO: 1
DATE:	10/8/2020	SCALE:	1 " = 200 '	PROJECT NO:	303-863

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