GEOTECHNICAL ENGINEERING INVESTIGATION REPORT

MEADOWS LANDING RESIDENTIAL DEVELOPMENT
SOUTH STRABANE TWP., WASHINGTON CO., PENNSYLVANIA

Prepared for:

KGA PARTNERS, LLC
PITTSBURGH, PENNSYLVANIA

MAY 2021

Prepared by:

GEO-MECHANICS, INC.
ELIZABETH, PENNSYLVANIA

GMI PROJECT NO. 21016

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May 12, 2021

KGA Partners, LLC
650 Washington Road, Suite 400
Pittsburgh, PA 15228

Attention: Mr. Hal A. Kester, Esq., CPA

Re: Geotechnical Engineering Investigation
Meadows Landing Residential Development
South Strabane Twp., Washington Co., PA
GMI Project No. 21016

Gentlemen:

GeoMechanics, Inc. (GMI) is pleased to present the report of its subsurface exploration and geotechnical engineering investigation for the above-referenced project site. This report contains the data obtained from the subsurface exploration and laboratory testing program obtained during the present investigation as well as the relevant data presented in the previous report prepared by GMI in June 2012 and ACA in September 2006. Additionally, the report includes the interpretation and analysis of these data with respect to the anticipated dwellings and infrastructure, critical cuts and embankments; and our recommendations concerning the preliminary foundation support systems, safe cut and fill slopes, roadway pavement, material utilization and special subgrade treatment.

We wish to extend our appreciation for this opportunity to be of service to you. Should you have any questions or require additional information, please contact us.

Very truly yours,

GEO-MECHANICS, INC.

Ryan J. Kossol, M.S., P.E.
Project Engineer

Javaid M. Alvi, Ph.D., President

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APPENDICES:

1.0 INTRODUCTION

1.1 Authority

This geotechnical engineering investigation has been performed in accordance with our cost estimate submitted to Mr. Hal A. Kestler, President of KGA Partners, LLC on March 2, 2021. Acceptance of this proposal and authority to proceed with the investigation was given to us by Mr. Brad Witucki through his email dated March 23, 2021.

1.2 Purpose and Objective of Investigation

The purpose of the investigation was to determine and characterize the subsurface geomaterials and to assess the local ground water conditions at the critical areas of the project site as well as evaluate their impact on the proposed site grading, pavement design, development of infrastructure and general earthwork construction criteria. An additional objective was to present a set of preliminary recommendations, based on the evaluation of site conditions concerning the most suitable, cost effective and safe foundation support for the residential structures with relevant geotechnical design parameters, pavement design, safe cut and fill slope design, special subgrade treatment, material utilization as well as general earthwork construction considerations.

1.3 Scope of Investigation

The scope of work performed by GeoMechanics, Inc. to achieve the above objectives consisted of the following:

- review of the available geologic and mining maps and the published literature related to the general area of the site;
- review of the previously performed geotechnical investigation report by GMI for Phase I in June 2012 (GMI project 12022);
- performance of a geologic reconnaissance of the site;

- drilling a total of seventeen (17) test borings at the proposed critical cut and fill slope areas;

- performance of laboratory soil tests to characterize the subsurface soils and determine their physical parameters;

- preparation of generalized subsurface profiles (geologic cross-sections) based on the extrapolation of the borings as well as laboratory test data illustrating the type, approximate thickness and spatial distribution of soil and rock as well as ground water conditions;

- performance of geotechnical evaluation of the subsurface soils, bedrock, and ground water conditions pertaining to the site grading, pavement sub-grade and buildable pads;

- performance of bearing capacity, slope stability, settlement and pavement analyses;

- preparation of a geotechnical investigation report documenting the data collected, analyses performed and conclusions drawn regarding to the behavior of subsurface materials with respect to the proposed site grading infrastructure and presenting a set of recommendations concerning the following:
  - -- preliminary type and depth of building foundations
  - -- geotechnical design parameters
  - -- cut and fill slope design
  - -- pavement design
  - -- special site preparation criteria
  - -- general earthwork construction considerations

2.0 FIELD DATA COLLECTION

2.1 Subsurface Exploration

The primary geotechnical feature of the site is its rugged topography which requires deep cuts and high fills to construct streets and flat buildable pads for the anticipated dwellings. This, in turn, requires evaluation of the materials into which cuts will be made and on which high embankments will be constructed. Determining the stability of the cut/fill slopes along with evaluation of the excavated material and its effective utilization over the site are the major geotechnical considerations. Therefore, the subsurface exploration performed for this investigation was focused on obtaining adequate subsurface information at the critical cut and fill areas and limited subsurface data at the anticipated building areas because the exact type and size of the buildings have not been finalized. The overall objective of the subsurface exploration was to identify the type, thickness and engineering properties of the soils; lithology and geomechanical characteristics of bedrock; and ground water conditions at the major cut and fill areas of the development site. To achieve this objective, a total of seventeen (17) test borings were drilled.

The locations of the borings are shown on the attached Test Boring Location Plan, Sheet No. 1 in Appendix C of this report. These borings were strategically located in an effort to develop generalized subsurface profiles across the critical cut and fill areas. The depths of the borings in the deep cut slope areas were selected to provide sufficient vertical overlap to develop accurate stratigraphic profiles. Similarly, the borings in the high fill slope areas were designed to provide sufficient information to develop slope stability models. Typically, the borings in the cut were extended to the proposed finished grade elevation. In the fill areas, the borings were terminated after encountering refusal on rock.

The depths of borings drilled at the site varied from a minimum of 10.0 feet to a maximum of 41.5 feet resulting in a total of 377.3 lineal feet of soil and rock sampled during this investigation. The borings were staked in the field and surface elevations were taken by Sheffler and Company, Inc. The elevations referenced in this report have been based on their surveys. The elevations of the borings are recorded on the Test Boring Records included in Appendix A and were also used to prepare the idealize Geologic Cross-Sections which are included in Appendix C of this report. The

drilling of the borings for this investigation was performed by GeoMechanics, Inc. during the month of April 2021. All borings were logged by our geologists, and the boring logs for the current study are included in Appendix A of this report. The relevant GMI Boring Logs from the previous study for Phase I in 2012 are also included for reference in Appendix A-1 and the relevant ACA boring logs from the previous 2006 and 2011 studies are included for reference in Appendix A-2.

The pertinent boring information from the past and present investigations is summarized on Tables No. 1A and 1B included in this report, and the methodology used in the collection of subsurface data is discussed below.

2.1.1 Soil Sampling

The soil sampling program consisted of obtaining Split Spoon (disturbed) samples by conducting Standard Penetration Tests (SPT) while advancing the test boring through the soil zone in accordance with ASTM Designated Method 1586-84. The samples were collected at 3-foot intervals by a 2-inch O.D. Split Spoon Sampler that was driven 18 inches into the soil with blows from a 140-pound hammer falling a distance of 30 inches. The number of blows required to drive the sampler for each 6-inch interval was recorded, and the cumulative number of blows for the last two 6-inch intervals is designated as "Standard Penetration Resistance" (SPT-N values). This value generally gives an indication of the relative density of granular soils or consistency of fine-grained soils which, in turn, could be related to the shear strength and compressibility of the in-situ soils. The SPT N-values (blow counts) at various depths, and the description of the soils based on visual identification and modified by laboratory soil classification tests are recorded on the Test Boring Records in Appendix A and are also plotted on the Geologic Cross-Sections included in Appendix C. In addition to spoon samples, several disturbed bulk samples were also obtained from borings located at the cut areas to determine maximum dry density, optimum moisture content, and CBR values.

2.1.2 Rock Coring

Bedrock was sampled continuously in three (3) of the seventeen (17) borings drilled across the project site using a diamond bit with an NQ2 double-tube, rigid-type core barrel which provides a 1.99-inch diameter core (ASTM Method: D 2113-83). The rock core samples were visually

identified in the laboratory. The presence of limestone or calcareous rocks was detected by using acid tests. The rock description, the core recovery for each coring interval, and the Rock Quality Designation (RQD) values (expressed in percent) for each lithologic unit are recorded on the boring logs presented in Appendix A. The RQD values reflect the quality and fracture spacing of the rock and are calculated as a summation of all unbroken core samples of 4 inches or more in length divided by the total length of each lithologic unit. The core recovery percentage and RQD values together provide a qualitative understanding of the geomechanical properties of the bedrock and are especially useful in assessing the load carrying capacity and excavatibility of bedrock.

2.1.3 Ground Water Reading

Efforts were made to measure the depth to ground water table immediately upon completion of each boring and, again, after 24 hours provided the bore holes had not caved or were not filled in for safety reasons. The ground water readings are included on the Test Boring Records and are also plotted on the Geologic Cross-Sections. These readings are used to establish the ground water regime at the site. In addition, the loss or re-gain of the drill water was recorded on the boring logs.

3.0 LABORATORY TESTING PROGRAM

This task formed the second phase of data collection and material characterization and consisted of index properties tests that include moisture content, sieve and hydrometer, and Atterberg limit tests. The data obtained from these tests were used in conjunction with standard penetration test data (SPT N-values) obtained from the borings to correlate to shear strength, compressibility and permeability parameters of soils. In addition, material behavior tests consisting of Proctor Compaction and California Bearing Ratio (CBR) tests were performed on the bulk samples of anticipated fill material taken from the cut areas. The data from these tests provide the moisture content/density parameters that are used in monitoring the field density of compacted fill and preparation of soil samples for subsequent CBR tests. All of the soil laboratory testing was performed in-house by GeoMechanics, Inc. The individual tests performed are briefly described below with our interpretation of the test results. The test results are presented graphically in Appendix B (Figures B-1 through B-14) and summarized on Table No. 2 of this report. The relevant laboratory tests results from GMI's 2012 investigation are also included in Appendix B-1 of this report.

3.1 Natural Moisture Content Test (ASTM: D 2216)

Natural moisture content tests were performed on eight (8) representative jar samples and two (2) bulk samples to evaluate the in-place water content of the soils at the time of drilling. Moisture content, expressed as the ratio of the weight of water to the weight of dry solids, for each sample tested is recorded on the Grain-Size Distribution Test Reports, Figures B-1 through B-10 in Appendix B and summarized on Table No. 2 of this report. The soil tested showed a water content value varying between 4.7 and 21.3 percent for samples tested. These values correspond to dry to moist conditions based on an emperical scale of dry, damp, moist and wet. However, these conditions will usually vary depending on seasonal and local precipitation, fluctuation of ground water table, and on the depth below ground surface, and should be taken into consideration when working with soils during construction. In general, the moisture content data provide an indication about the physical condition of the in-place materials and, in turn, their strength and compressibility.

3.2 Classification Test (ASTM: D 2487)

The gradation (sieve and hydrometer) tests and the Atterberg Limits tests are used as the basis for classifying and identifying both granular and fine-grained soils. Together, they form what is commonly referred to as a Classification Test. A brief description of each test is given below.

3.2.1 Gradation Test (ASTM: D 422)

Ten (10) representative soil samples which were selected for the moisture content tests were also selected for conducting sieve and hydrometer tests. The data from these tests, in conjunction with the data obtained from the Atterberg Limits tests, were used to classify the soils according to the Unified Soil Classification System. These soil classifications are shown on the Grain Size Distribution Test Reports (Figures B-1 through B-10) and summarized on Table No. 2 of this report. Based on the laboratory test data, all ten (10) soil samples tested are classified as fine-grained silty clays (USCS classification CL).

3.2.2 Atterberg Limits Test (ASTM: D 4318)

The Atterberg Limits tests were conducted on the same ten (10) samples on which gradation testing was performed. The results of these tests are included on the Grain-Size Distribution Test Reports (Figures B-1 through B-10) in Appendix B and summarized on Table No. 2. The results have been used in conjunction with the results of the sieve and hydrometer analysis to classify the soils according to the Unified Soil Classification System and the American Association of State Highway and Transportation Officials Methods (AASHTO: M1450-82). The Liquid Limits (LL) of the soils tested range from 33 to 49 percent with a Plastic Index (PI) ranging from 12 to 27 percent. This indicates that the in-situ soils are slightly to moderately plastic.

3.3 Modified Proctor Compaction Tests (ASTM: D 1557)

Two (2) Modified Proctor Compaction tests (ASTM: D-1557-12, Method C) were performed on bulk samples taken from test boring TB-5 and TB-15. The tests were conducted to determine the density-moisture content relationship, which forms the basis for field compaction control, and to prepare the specimen for the CBR test. The maximum dry density of the test samples ranged

from 123.7 PCF at 12.7 percent optimum moisture to 127.3 PCF at 10.4 percent optimum moisture and are presented on Figures B-11 and B-12 in Appendix B. It may be pointed out that the natural moisture content of the soil tested was below the optimum moisture content.

3.4 California Bearing Ratio (CBR) Tests (ASTM: D 1883)

The CBR tests were conducted on the same residual soil samples on which the Compaction tests were also performed. The optimum moisture content and density values obtained from the Compaction tests were used in the preparation of the CBR test specimens. The purpose of the CBR tests was to determine the shear strength of the compacted soil that will form the pavement subgrade. The CBR value is used in designing the pavement thickness of the roadways. The test results are presented in the form of a stress-penetration curve on Figures B-13 and B-14 in Appendix B of this report. In the samples tested, the laboratory-determined CBR value at 0.01 inch and 0.02-inch penetration varied from 4.3 to 2.4 and 4.5 to 2.6, respectively. Therefore, for common fill material, a CBR value of 3 appears to be the representative value for the pavement design.

4.0 GENERAL SITE CONDITIONS

4.1 Project Location and Topography

Topographically, the site is comprised of a north-south trending ridge with sides sloping mildly towards the north and south-southeast culminating in two (2) gullies where intermittently flowing creeks are located. The following site assessment is based partly on review of the relevant published geomorphic, soil and geologic and mining maps and literature and partly on site-specific subsurface information obtained during the past and present investigations.

The project site is bounded by PA Route 19 (S.R. 0019) along the east side, a county road along the north and west sides, and an undeveloped tract of property along the south side (Figures 1 and 2). The ground surface elevation within the project area varies from about 1310± feet at the top of the hill to about 1100± feet near the creek along the west side of the site. The intermittent creeks flow into tributaries of Chartiers Creek. Some cut and fill have been performed during previous development phases in the area that lies immediately adjacent to S.R. 0019.

4.2 Soil Type

According to U.S. Soil Conservation, the soil type in this area belongs to "Guernsey-Culleoka-Dormont-Library association" (see Figure 3). These are moderately well-drained, nearly level to sloping soils on terraces and in the uplands. They are formed in residuum of weathered shale, siltstone, sandstone and limestone. Except near the stream bank where the soil type is mostly alluvial (silty clay to clayey sand and gravel), the natural soil mantle in the project area is dominantly residual and colluvial in origin. The average thickness of the natural soil is about 15 feet. Strength tests performed on similar soils from the nearby area as well as during the previous study for Phase I suggest the existing residual soils have moderate shear strength, low compressibility and low permeability.

4.3 General Geology

Figure 4 represents the geologic map of the project area and its environs and indicates that the subcropping bedrock below the soil mantle is sedimentary in origin and belongs to the Washington and Waynesburg Formations of the Dunkard Group along with the Uniontown and Pittsburgh

Formations of the Monongahela Group which are Lower Permian and Upper Pennsylvanian in age, respectively.

The Washington Formation is typically divided into Upper Limestone Member, Middle Member and Lower Limestone Member with Washington coal seam as its basal unit. A generalized stratigraphic column with descriptions of the various rock units is presented on Figure 5. The Waynesburg Formation is also divided into the Upper Member, Middle Member and Lower Member. The Little Washington coal bed separates the Upper Member from the Middle Member and the Waynesburg "A" coal marks the dividing bed between the middle and the underlying Lower Member, and the Waynesburg coal bed separates the Lower Member from the underlying Uniontown Formation. The Uniontown Formation is divided into the Upper Member and Lower Member with the Uniontown coal bed as the dividing layer between the Uniontown Formation and the next lower Pittsburgh Formation. Only the Upper Member of the Pittsburgh Formation is located at the project site and subcrops at the toe of the hillsides.

Structurally, the site is located on the eastern limb of the northeast-southwest trending axis of the Washington Anticline that plunges towards the northeast. As a result, the bedrock strata are dipping towards the southeast at an average rate of 3 percent that will result in approximately 50 feet drop in the bedrock strata proceeding from the northern limit of the project site to the southern limit to S.R. 0019 (see Figures 4 and 6). This could result in different rock types exposed at the bearing elevations of buildings and pavement.

4.4 Coal Seams

The Pittsburgh coal, an extensively mined coal seam in this area, is available under the site at an elevation of 860 feet to 800± feet (say, average 830± feet) with a dip of 2 to 3º towards the southeast. The coal has been deep mined under the site by Willet Coal Company utilizing the room-and-pillar method (see Figure 7). The mine voids will remain at a depth of 240 feet at the creek levels to 460± feet at the hilltops of the property, which is significantly below the proposed site grades. Therefore, the risk of damage to the structures due to subsidence caused by any future collapse at the mine level is slight at this site.

The Waynesburg coal, which is available under the site at an elevation ranging from 1080± feet to 1140± feet, is not known to have been deep mined in this area (see Figure 8). But it might have been strip-mined locally where it crops out along the sloping hillside and along the gully banks. At still higher elevation of about 1130 to 1180± feet, a thin seam of Waynesburg "A" Coal may also be encountered in the soil or the rock zone. This seam is often bony and impure and is not known to be mined using deep mining method in this area. Other thin coal beds of the Waynesburg/Washington formations may be encountered at a higher elevations (about 1260± feet). These coal seams are impure and have no economic value and, therefore, rarely strip mined and practically never deep mined.

5.0 DISCUSSION AND EVALUATION OF SUBSURFACE CONDITIONS

In this section the data obtained from the subsurface exploration and laboratory testing programs conducted during the present and previous (June 2012) investigations by GeoMechanics, Inc. and the relevant data obtained by ACA during their geotechnical investigations of September 2006 have been utilized to evaluate the geotechnical aspects of the subsurface geomaterials as they relate to the safe construction of embankments, cut slopes and foundation bearing materials. Considering the topographic feature of the site and the needed site grading to develop the buildable pads, general subsurface conditions across the entire project and specific conditions at the critical cut and fill embankment area are discussed separately as follows.

5.1 General Subsurface Conditions

The three (3) basic components of subsurface geomaterials namely, soils, bedrock and ground water across the entire project site are discussed separately as follows.

5.1.1 Soils Conditions

Based on the data collected from a total of thirty-three (33) borings, B-3, B-4, B-6 through B-9, GB-18 through GB-25 and TB-1 through TB-17, it appears the site is covered with a soil zone averaging 18 feet. The soil mantle consists primarily of residual soils with isolated areas where some colluvial soils overlay the residual soils. However, at the western-southwestern part of the site considerable fill on top of residual soils had been placed during the previous site grading operations to develop the present grades and small amounts of this fill were encountered in several test borings in that vicinity.

The residual soils are derived by in-place weathering of rock; therefore, their composition is affected by the lithology of parent rock and the intensity of weathering. Typically, the upper part of the residual soil layer regardless of the parent bedrock is fine-grained silty clay with sand as the secondary constituent. With increasing depth as the intensity of weathering decreases, the soils become more coarser grained clayey sand to clayey gravel with some silt except when bedrock is claystone/clayshale or limestone. The weathered product of claystone/clayshale and limestone rocks

remains fine-grained silty clay, some of which may be highly plastic (fat clay). The colluvial soils were generally fine-grained in composition and are classified as silty clay with variable percentages of sand as the secondary component. In general, the soil mantle across the site will form adequate common fill when properly moisture conditioned. As a foundation bearing medium, residual soils will provide moderate strength and compressibility and will be suitable for support of shallow foundations designed with a net allowable bearing capacity of 2 KSF. When properly placed and compacted, the common fill can also provide 2 KSF net allowable capacity. However, the long-term settlement will depend on the thickness of fill, underlying residual/colluvial soil and the "rest period" to allow the engineered fill to consolidate under self-weight.

Embankments constructed using the soil material available from the cut areas will provide moderate effective shear strength parameters, cohesion (c) in the range of 200 to 300 PSF with corresponding effective angle of internal friction in the range of 26 to 28 degrees. As a pavement subgrade, the on-site soils both in-situ and compacted fill will make average material capable of providing a California Bearing Ratio (CBR) of 3.

5.1.2 Bedrock Conditions

The existing ground surface within the development area varies from a highest elevation of 1315± feet to a lowest elevation of 1105± feet, a relief of about 210± feet. One (1) boring, GB-5, from the previous investigation was located near the highest point of the site and drilled to a depth of 120 feet or elevation 1188± feet. A graphical distribution of the various rock units within this interval is presented on Geologic Cross-Section P-P. It is apparent from this geologic section that the bedrock underlying the soil mantle consists of interbedded layers of shale, limestone, claystone and sandstone with thin coal seams. The stratigraphic sequence shown on the geologic cross-section consists of, from top to bottom, as follows:

Fine-Grained Sandstone (Elevation 1293 to 1283±, Borings GB-5, TB-11):

It is thinly laminated to thickly bedded, broken to massive and medium hard to hard. This rock layer extends down to elevation 1283± feet along the southern limit of the development site. The core recovery in this layer is good

but RQD is very poor (21%). Therefore, excavation into this rock can be made without blasting.

Silty Shale (Elevation 1284 to 1276±, Boring GB-5):

This approximately 8± foot thick rock unit is thinly laminated, broken and soft. It is typically moderately weathered with thin highly weathered zones. In spite of good core recovery, RQD rating is very poor (0%). Accordingly, the shale has moderate strength. Excavation into this rock unit should not be difficult.

Carbonaceous Shale & Coal (Elevation 1283 to 1271±, Boring GB-5, TB-11):

This rock layer is thinly laminated, highly to completely weathered, very broken and very soft. The core recovery was good and the RQD rating (0%) was very poor. As a result, it has low strength and can be excavated easily. Where present, within 5 feet of the finished floor elevation and 3 feet below the footings and pavement, carbonaceous shale should be overexcavated and replaced with properly compacted suitable inert material.

Limestone & Claystone Interbeds (Elev. 1271 to 1249±, Boring GB-5, TB-11):

It is very thinly to thinly bedded, very broken to blocky, limestone seams are hard and claystone seams are very soft, which resulted in very poor core recovery and RQD values. Excavation into this rock can be made using mechanical equipment. Again, the excavated material will contain large-size limestone boulders in a clayey matrix.

Carbonaceous Shale & Coal (Elevation 1249 to 1242±, Boring GB-5, TB-4):

This stratum is thinly laminated, very broken to broken and soft to medium hard. This coal seam is 3 to 18 inches in thickness and forms the basal section of this pyrite rich carbonaceous shale. Core recovery values are fair to good, but RQD is very poor. Therefore, this rock layer has low to moderate

strength. The coal is bony in nature and is, most probably, the Little Washington Coal seam.

Sandstone/Siltstone/Shale (Elev. 1242 to 1212±, Borings GB-5, TB-4):

This rock interval is comprised of fine-grained sandstone and silty to sandy shale layers. There are considerable lateral and vertical gradations within this group and the various araneous rock units grade into one another. This rock interval is thinly laminated to very thinly bedded. Rock drill cores were broken to blocky and medium hard. The core recovery values were excellent and the RQD values varied between 0 percent in TB-4 and 26 to 55 percent in GB-5, which are rated as very poor to fair. In general, this rock interval has moderately high strength and excavation into the shale and siltstone rock can be made without much difficulty using mechanical equipment while use of presplitting and hoe ramming will most likely be needed in the sandstone rock strata, if encountered. The excavated shale and siltstone rock when placed in embankment and compacted will breakdown into smaller pieces and will generate considerable fines and may not be suitable for rock needed for the toe benches but will provide good common fill material. The sandstone rock is unlikely to break down and would provide competent material for use in a rock toe.

Limestone (Elevation 1212 to 1205±, Borings GB-5):

A thinly to thickly bedded limestone was sampled from elevation 1212 to 1205± feet in Boring GB-5. Based on the current site layout, it does not appear this layer will be exposed in any of the cuts, making it a non-factor for this project.

Siltstone/Shale/Claystone (Elevation 1198 to 1188±, Borings GB-5, TB-1):

This layer is sandwiched between the upper and lower limestone benches. This rock unit is thinly laminated to thinly bedded, broken to blocky, soft to medium hard and moderately to completely weathered. It does have about 1±

foot of pyritic carbonaceous shale at the bottom which should be excavated and removed, and the excavated area backfilled with suitable inert material, if encountered at subgrade elevation for pavement or floor slab/footing elevation at buildings.

Limestone (Elevation 1212 to 1205±, Borings TB-1):

It is thinly to thickly bedded, blocky to massive, hard, and slightly to completely weathered. Core recovery is excellent while RQD is poor (38%) likely due to sporadic clay seams throughout. Excavation into this rock can be made using mechanical equipment. Again, the excavated material will contain large-size limestone boulders which can be used in the rock toes within a clayey matrix.

5.1.3 Ground Water Conditions

Stabilized ground water levels were measured in eight (8) of the test borings ranging from 7.2 feet (Elev. 1248.9 feet) in Boring TB-4 to 31.4 feet (Elev. 1180.2 feet) in Boring TB-5. No static ground water was encountered in the remaining nine (9) test borings; however, perched ground water tables can be expected, the uppermost generally coinciding with soil-rock contact and confined to coal seams or jointed rocks with high hydraulic conductivity such as limestone. Ground water may seep out along these horizons in some of the cuts and may require treatment to collect and channel the seepage water to the nearest stormwater inlets.

Embankment areas will also require underdrains in the bonding benches and rock toe benches to collect and remove the water in order to avoid saturation and the resulting instability.

5.2 Specific Site Conditions at Critical Areas

5.2.1 Area 1: Lot Numbers 267 through 297; Borings TB-1, TB-2, TB-3

This area is located at the far southern end of the property and includes lot numbers 267 through 297. A total of three (3) standard test borings, TB-1 through TB-3, were drilled in Area

1 during the present investigation. The data from these borings has been plotted on the generalized Geologic Cross-Sections A-A and B-B on Sheet No. 2 in Appendix C of this report. The lots at the west end of this area will be created by constructing a 50± foot high fill embankment (near lot 272) while the lots at the south end of the area (near lot 276) will be created by constructing a 45± foot deep cut slope. Minor cuts and fills will be required across the remaining lot areas.

Soils Conditions

A review of these cross-sections indicates that the area over which the high embankment will be constructed is covered with a moderately thick soil zone of about 17± feet. The soil zone in this area is comprised entirely of residual soils. The upper residual soils are classified as a fine-grained silty clay with varying amounts of sand and gravel and a medium to very stiff consistency. The lower residual soil layer, which is essentially a decomposed or highly weathered bedrock was classified as a granular silty gravel with a very dense relative density. Therefore, the residual soils have moderate to high shear strength and moderate to low compressibility and the bonding benches could be constructed in these soils. The toe bench will typically be extended down to bedrock where the rock is relatively shallow; where the residual soils are exceptionally thick, the bottom of the toe bench may have to be constructed in the lower more competent residual soil zone.

The area where the deep cut will be constructed also consists entirely of residual soils. The uppermost soil layer consists of medium dense to very dense carbonaceous shale and coal. Underlying the carbonaceous shale and coal are alternating layers of decomposed shale and sandstone bedrock which vary from fine-grained silty clay to granular clayey sand. These soils have a hard consistency when fine-grained and a very dense relative density when granular. All soils removed from this cut slope beneath the carbonaceous shale and coal can be used as fill elsewhere on the site while the coal and carbonaceous shale can be used as fill in the deeper part of the embankments where its pyritic traits will not interfere with the roadways and building structures.

Bedrock Conditions

Bedrock was encountered in Boring TB-1 at the base of the proposed cut slope. The upper bedrock consisted of a very soft to soft, broken to blocky siltstone/silty shale. This 5-foot thick layer should be relatively easy to excavate using methods such as rock teeth on an excavator,

ripping with a dozer, or hoe-ramming depending on the degree of hardness. The lower bedrock stratum, located at the finished floor elevation of the lots, is a broken to blocky, hard limestone. This layer will be much harder to excavate and will likely need to be hoe-rammed or blasted when encountered.

Ground Water Conditions

Stabilized ground water was encountered in Boring TB-1, located in the cut area, at a depth of 27.3 feet which corresponds to elevation 1207± feet. The stabilized groundwater was measured at a relatively shallow depth confined to the soil zone and represents water perched on top of the lower less permeable soil or rock. It is typically much shallower near the anticipated toe of the embankment then at the upslope area. The gradient of this uppermost perched water table is from east to west and, in general, parallels the existing ground surface slope. It is likely to rise after the placement of new fill and could adversely impact the stability of the embankment. Therefore, underdrains suitability located in the bonding benches will be needed to depress the groundwater table and avoid saturation of the fill as well as the subgrade material as water is generally the major cause of embankment slides. Additionally, any groundwater seepage coming from a cut slope will need to be contained.

5.2.2 Area 2: Lot Numbers 250 through 266; Borings GB-19 through GB-25

This area is located at the southwest corner of the property and includes lot numbers 250 through 266. A total of six (6) standard test borings, GB-19 through GB-25, were drilled in Area 2 back in 2012 for the proposed site conditions during the previous 2012 investigation. The data from these borings has been plotted on the generalized Geologic Cross-Sections C-C through E-E on Sheet No. 3 through 5 in Appendix C of this report. The lots in this area will be located on top the previously constructed fill embankments. Recommendations for constructing this fill embankment were provided in GMI's previous GEIR from 2012. During construction, ACA Engineering was the geotechnical representative retained by KGA Partners to monitor the site work. Minor cuts and fills will be required to reshape the grading at this location for the current development.

5.2.3 Area 3: Lot Numbers 114-152, 200-249; Borings TB-5, TB-7-10, TB-12, TB-14, B-9

This area is located along the western half of the property and includes lot numbers 114 through 152 and 200 through 249. A total of six (6) standard test borings, TB-5, TB-7 through TB-10, TB-12, and TB-14, were drilled in Area 3 during the past and present investigations. The data from these borings has been plotted on the generalized Geologic Cross-Sections F-F, G-G, H-H, J-J, K-K, and L-L, on Sheet No. 6-11 in Appendix C of this report. The lots along the north and west sides of the road in this area will be created by constructing up to 60± foot high fill embankments while the lots along the east and south sides of the roadway will be created by constructing up to 40s± foot deep cut slopes.

Soil Conditions

A review of these cross-sections indicates that the area over which the high embankment will be constructed is covered with a moderately thick soil zone varying from 10± to 16.5± feet thick. The soil zone is comprised of man-made fill, colluvial, and residual soils. The fill soils were encountered in Boring TB-12, which is located at the toe of the proposed embankment near an area that was previously developed. These soils are 3± feet thick at the boring location and are classified as a fine-grained silty clay with "trace" sand and "trace" gravel and a stiff consistency. The fill soils have low shear strength and will likely be removed during construction of a rock toe. Colluvial soils were encountered in Borings TB-10 and TB-13 with a thickness ranging from 3.0± to 7.5± feet. The colluvial soils are classified as a fine-grained silty clay with variable amounts of sand and gravel and have a medium to stiff consistency indicating low shear strength and high compressibility. Thus, they will be removed as needed when constructing the rock toe and bonding benches for the new embankment.

The upper residual soils are comprised of both a fine-grained silty clay with varying amounts of sand and gravel and a granular silty to clayey sand and gravel. These soils have a medium to very stiff consistency when fine-grained and a medium dense relative density when granular. The lower residual soil layer, which is essentially a decomposed or highly weathered bedrock was classified as a granular silty sand to silty gravel with a medium dense to very dense relative density. Therefore, the residual soils have moderate to high shear strength and moderate to low compressibility and

the bonding benches could be constructed in these soils. The toe bench will typically be extended down to bedrock where the rock is relatively shallow; where the residual soils are exceptionally thick, the bottom of the toe bench may have to be constructed in the lower more competent residual soil zone. Additionally, a 3± foot coal seam (Washington coal) was encountered in Boring TB-13 at approximate elevation 1225± which corresponds to the elevation of the cut/fill transition zone seen on Geologic Cross Section L-L. The recommended slope treatment at this location, which will be discussed later in this report, will likely be influenced by this coal seam.

The area where the deep cut will be constructed also consists of both colluvial and residual soils. The uppermost colluvial soil layer consists of medium to stiff fine-grained silty clay. An upper layer of residual soil was encountered directly beneath the colluvial soils. This upper residual layer is comprised of fine-grained silty clay with "trace" amounts of sand and gravel and a stiff to very stiff consistency. Directly beneath the upper layer of residual soils, a 6± foot thick layer of coal and carbonaceous shale was encountered at approximate elevation 1200± in both cut borings (TB-5 and TB-14). This layer has a dense to very dense relative density. As stated previously, the coal and carbonaceous shale excavated during construction of the cut slope can be used as fill within the deeper parts of the fill embankments but should not be used when placing fill within 5 feet of floor slab, footing, or pavement subgrade elevation. Lastly, a lower layer of residual soil was encountered which is comprised of fine-grained silty clay and granular clayey sand with varying amounts of sand and gravel. This layer is essentially a decomposed claystone and limestone, which has a hard consistency when fine-grained and very dense relative density when granular depending on the degree of weathering. This layer has moderate to high shear strength and low compressibility and will form the finished floor and foundation subgrade elevation for the proposed buildings along the south and east sides of the roadway.

Bedrock Conditions

Although bedrock was not sampled in any of the borings, the SPT N-values at the two cut slope borings (TB-5 and TB-14) reflect that the relative density of the lower residual soil is very dense and likely will require excavation methods such as ripping with a dozer or hoe-ramming to achieve the desired finished grade.

Ground Water Conditions

Ground water was encountered in four (4) borings in this area, ranging from a depth of 7.6± feet in Boring TB-10 (Elev. 1137±) to a depth of 31.4 feet in Boring TB-5 (Elev. 1180±). The stabilized groundwater was measured at a relatively shallow depth confined to the soil zone and represents water perched on top of the lower less permeable soil or rock. It is typically much shallower near the anticipated toe of the embankment then at the upslope area. The gradient of this uppermost perched water table, in general, parallels the existing ground surface slope. It is likely to rise after the placement of new fill and could adversely impact the stability of the embankment. Therefore, underdrains suitability located in the bonding benches will be needed to depress the groundwater table and avoid saturation of the fill and the subgrade material as water is generally the major cause of embankment slides. Additionally, the coal seams and limestone layers such as those encountered in the cut slope borings TB-5 and TB-14 are considered good ground water carriers. Surface ground water seepage along the cut face can be expected along the limestone/claystone and coal contact lines. However, because of the limited recharge area, the amount of seepage is expected to be small.

5.2.4 Area 4: Lot Numbers 324-335; Boring TB-9

This area is located in the middle of the property and includes lot numbers 319-335. Only one (1) standard test boring, TB-9, was drilled in Area 4 during the present investigation. The data from this boring has been plotted on the generalized Geologic Cross-Section I-I on Sheet No. 9 in Appendix C of this report. The lots along the west sides of the roadway in this area will be created by constructing up to 35± foot high fill embankments while the lots along the east side of the roadway will be created by making minor cuts.

Soils Conditions

A review of these cross-sections indicates that the area over which the fill embankments and the minor cuts will be constructed is covered with a moderately thick soil zone of about 20± feet. The soil zone is comprised of colluvial and residual soils. A 9± foot thick colluvial soil zone was encountered in Boring TB-9. The colluvial soils are classified as a fine-grained silty clay with stiff consistency to a granular clayey sand with medium dense relative density. These soils have low shear

strength and high compressibility and will be removed as necessary when constructing the rock toe and bonding benches for the new embankment.

The residual soils are comprised of a silty to clayey gravel and sand with medium dense to very dense relative density. Therefore, the residual soils have moderate to high shear strength and moderate to low compressibility and the bonding benches could be constructed in these soils. The toe bench will likely be keyed into this competent residual soil layer at this location due to the greater depth to bedrock.

Bedrock Conditions

Bedrock was not sampled in this area of the site; however, it is expected to be encountered at a depth of 20± feet.

Ground Water Conditions

A stabilized ground water level was encountered at a depth of 10.2 feet in Boring TB-9. It is, however, recognized that perched water table does fluctuate depending upon the seasonal precipitation. It is also recognized that ground water regime will change after the site grading has been completed and may be much higher. Therefore, it will be prudent to incorporate underdrains in the bonding benches and toe bench in order to depress the ground water table and avoid the saturation of the embankment fill, thus improving the stability of the embankment.

5.2.5 Area 5: Lot Numbers 300-323; Borings TB-4, TB-6, TB-11, TB-13, TB-16, GB-5, B-3, B-8

This area is located along the western edge of the property and includes lot numbers 300-323. A total of eight (8) standard test borings, were drilled in Area 5 during the past and present investigations. The data from these borings has been plotted on the generalized Geologic Cross-Sections L-L and O-O through S-S on Sheet No. 11 and 13-17 in Appendix C of this report. The lots along the south and west sides of the roadway in this area will be created by constructing deep cut slopes while the lots along the north and east side of the roadway will be created by constructing fill embankments up to 35± feet high.

Soil Conditions

A review of these cross-sections indicates that the area over which the fill embankments will be constructed (Section L-L, O-O, S-S) is covered with a moderately thick soil zone varying from 11± to 14± feet thick. The soil zone is comprised of man-made fill, colluvial, and residual soils. The fill soils were encountered in Borings TB-6 and B-8, which are located near the previously developed area. It is also possible that since the coal is so shallow at this location that these soils were backfilled after the coal was locally stripped from this area. These soils are 3 feet thick and are classified as a fine-grained silty clay with varying amounts of sand and gravel and a stiff consistency. The fill soils have low shear strength and will likely be removed during construction of a rock toe and bonding benches. Colluvial soils were encountered in Boring TB-13 and TB-16 with a thickness of 3± feet. The colluvial soils are classified as a fine-grained silty clay with varying amounts of sand and gravel and a medium to stiff consistency. These soils have low shear strength and high compressibility and will also be removed as much as required when constructing bonding benches for the new embankment.

The upper residual soils at the fill embankments are classified as a fine-grained silty clay with variable amounts of sand and gravel as secondary constituents, while the lower residual soils are comprised of a granular clayey gravel which is essentially a decomposed bedrock. Additionally, a coal/carbonaceous shale seam was encountered at approximate elevation 1205± in Borings B-8 and 1225± at TB-13, likely corresponding to the Waynesburg and Washington coal seams, respectively. The residual soils typically have a very stiff to hard consistency when fine-grained and a very dense relative density when granular. Therefore, the residual soils have moderate to high shear strength and moderate to low compressibility and the bonding benches could be constructed in these soils. The toe bench will typically be extended down to bedrock where the rock is relatively shallow; where the residual soils are exceptionally thick, the bottom of the toe bench may have to be constructed in the lower more competent residual soil zone.

A review of these cross-sections indicates that the area where the cut slopes will be constructed (Section L-L, O-O, P-P, Q-Q, R-R) is covered with a moderately thick soil zone varying from 10± to 25± feet thick. The soil zone is comprised of both colluvial and residual soils. The

colluvial soils are classified as a fine-grained silty clay with varying amount of sand and gravel. These soils vary range in thickness from 3 to 9± feet and have a medium to stiff consistency. These soils can be used as common fill elsewhere on the site, provided they are placed under proper compaction and moisture control.

The upper residual soils at the cut slope locations are also classified as a fine-grained silty clay or a granular clayey sand depending on the degree of weathering. These soils typically range in thickness from 3 to 12± feet and have a medium stiff to hard consistency when fine-grained and a loose to dense relative density when granular. A coal/carbonaceous shale seam was encountered at elevation 1200± in Boring TB-14, likely corresponding to the Waynesburg coal seam. As previously stated, the coal and carbonaceous shale material excavated during cut slope construction can be used as fill in the lower portions of the embankments while the remaining residual soil can be used in all locations, provided they are placed under proper compaction and moisture control. The lower residual soils at these locations are comprised of both a fine-grained silty clay or a granular clayey sand/gravel depending on the parent bedrock and the degree of weathering. Soils derived from limestone and claystone tend to be more clayey compared to those derived from sandstone or siltstone. These soils have a hard consistency when fine-grained and a very dense relative density when granular and have moderate to high shear strength and low compressibility making them ideal for use as a bearing stratum for the floor slab subgrade and building foundations.

Bedrock Conditions

Bedrock was only sampled in three (3) of the cut slope borings (TB-4, TB-11, and GB-5). Bedrock excavated from the cut slopes at geologic cross sections Q-Q and R-R will be very similar and include in descending order sandstone, carbonaceous shale/coal, and limestone. The sandstone bedrock is thinly laminated to thickly bedded, broken to massive, and medium hard to hard indicating this rock layer will likely need to be ripped with the dozer or hammered with the hoe-ram to excavate. This rock can be utilized in the construction of the rock toes throughout the site, assuming it is broken down the proper size. The coal/carbonaceous shale seam encountered at approximate elevation 1275± in TB-4 and TB-11 is thinly laminated, very broken to broken, and very soft, indicating that excavation through this material should be relatively easy. As previously stated, the coal and carbonaceous shale can be utilized as fill in the deeper parts of the fill embankments as to not interfere with the building

structures and roadways. Approximately 4 to 5± feet of limestone beneath the coal seam will need to be excavated to reach the proposed finished grade at these locations. This limestone, which has sporadic clay seams throughout, is thinly to thickly bedded, broken to blocky, and very soft to hard. Excavation into this rock layer may be difficult at times and will require hoe-ramming but can also be very easy when soft clay seams are encountered. The limestone boulders removed from this cut can be utilized in rock toes throughout the site, provided they are broken down to the proper size.

The bedrock encountered in TB-4 (Section R-R) consists of an upper layer of shale which is thinly laminated to very thinly bedded, broken to blocky, and medium hard followed by a lower layer of siltstone/sandstone that is very thinly to thinly bedded, broken to blocky, and medium hard. All of these rock units should be relatively easy to excavate and will easily break down into very good fill material under the weight of the compaction equipment. This rock can be utilized anywhere in the fill slopes but is not suitable for use in the rock toe benches.

Ground Water Conditions

Stabilized ground water levels were measured at depths ranging from 7.2 feet in TB-4 to 32.8 feet in TB-11 with corresponding elevations of 1249± and 1273±, respectively. Both of these readings correspond closely to the elevations of the coal seams, indicating the coal is causing a perched water table at these locations. Slight seepage coming from the cut slopes is likely to occur at these elevations but should not pose any major issues during construction.

5.2.5 Area 6: Lot Numbers 100-113, 153-159; Borings TB-15, TB-17, P-3

This area is located along the northern edge of the property and includes lot numbers 100-113 and 153-159. A total of three (3) standard test borings were drilled in Area 6. The data from these borings has been plotted on Geologic Cross-Sections M-M through O-O on Sheet No. 12 and 13 in Appendix C of this report. The three easternmost lots and the seven southernmost lots in this area will be created by constructing deep cut slopes in the range of 30 to 50± feet while the northernmost lots will be created by constructing fill embankments up to 40± feet in height.

Soil Conditions

A review of these cross-sections indicates that the area over which the fill embankments will be constructed (Section N-N) is covered with a moderately thick soil zone of about 15± feet thick. The soil zone is comprised entirely of residual soils. The upper residual soils are comprised of a granular clayey sand with loose to medium dense relative density while the lower residual soils are comprised of a granular silty gravel with very dense relative density. These lower residual soils are essentially a decomposed sandstone bedrock with high shear strength and low compressibility and will likely form the bearing strata for the proposed rock toe bench.

The soil zone at the cut slope locations consists of both colluvial and residual soils. The colluvial soil zone will be approximately 3± feet thick along the cut slope face and is classified as a fine-grained silty clay with medium to stiff consistency and will have little to no impact on the proposed structures. The upper residual soil zone at the cut slopes also consists of a fine-grained silty clay with "some" sand and "trace" to "little" gravel and has a stiff to hard consistency. The lower residual soils which will form the subgrade elevation for the proposed buildings and roadways consist of a very dense clayey sand which is essentially decomposed shale bedrock. These soils have moderate to high shear strength and low compressibility and will be suitable for use as a bearing stratum for floor slabs, pavement, and building foundations.

Bedrock Conditions

Bedrock was not sampled in any of the three (3) borings that were drilled within this area. However, the estimated bedrock is anticipated at a depth of 15± at the fill embankments and 25 to 30± feet at the cut slope locations. If bedrock is encountered within the depth of the proposed cut, it should be in a highly weathered, near soil state and will likely be very easy to excavate.

Ground Water Conditions

Only one (1) stabilized ground water reading was encountered in the borings in this area, as the remainder of the borings were dry. Stabilized ground water was encountered at a depth of 26.1 in Boring TB-15 which corresponds to elevation 1164±. Seeing how this single reading was so deep near the top of rock and there were no other readings, ground water is not expected to be a

significant issue in this area. However, it should be realized that the water tables are expected to rise due to seasonal and local precipitation and any future excavation extending below these water tables could cause significant water seepage. Additionally, the addition of new fill in the area of the fill embankments will likely cause the groundwater level to rise in the future.

5.3 Roadway Alignments

Road 01

A review of Centerline Profile for Road 01 indicates very little cut and fill will be needed to achieve the desired roadway subgrade from Station 0+00± to Station 10+00±. Therefore, the pavement subgrade will consist of existing soils or 0± to 5± feet thick new fill. From Station 10+00± to Station 15+50±, the roadway will be constructed on newly placed fill, with the composition of new fill expected to be similar to that of the existing soil cover. From Station 15+50± to Station 17+30±, a cut into the residual soils will be needed to reach the roadway subgrade. Thus, it is apparent from the above discussion that the pavement subgrade will vary from the upper part to the lower part of the existing soil zone to newly placed compacted fill. Subgrade should be prepared following the criteria presented in Site Preparation, Section 7.1.3 and the pavement can be designed using CBR value of 3, which is a typical value for subgrade consisting of silty clay to clayey sand soils.

Road 02

This road is approximately 1750± feet long and will traverse over the higher elvations along the east side of the site. As a result, practically the entire roadway will be constructed in cut. The depth of cut will range from less than 5 feet to as much as 30± feet near Station 10+50± along the centerline. The roadway subgrade from Station 0+00± to 8+00± will consist primarily of residual soils with the exception of a small 100± feet stretch from Station 1+25± to Station 2+50± where cut may extend a few feet into bedrock. The subgrade soils will vary from medium stiff silty clay where the cut is shallow to and medium dense to very dense clayey sand and clayey gravel (rock fragments) where the cut extends into the basal part of the residual soil zone. However, the pavement design should be based upon the more conservative value associated with the upper part of residual soil mantle.

From approximate Station 7+75± to Station 13+00±, the pavement subgrade will predominantly consist of medium hard to hard limestone. While this rock forms excellent pavement subgrade, excavation into the rock to install utilities may require presplitting and hoe ramming. Due to the blocky nature of limestone, overexcavation is most likely to occur and additional quantities of base course will be needed to fill in the depressions. It is also pointed out that transition benches along the soil/bedrock interfaces at both ends of this section of the roadway will be needed to alleviate the possibility of stress concentration and associated pavement crack development.

From Station 13+00± to the end of the roadway at Station 17+50±, the pavement subgrade will consist of residual soils. The residual soils are expected to vary from a high strength basal part to low strength upper part. Therefore, it will be prudent to continue using the conservative CBR value of 3 for the roadway pavement design.

Road 03

This 3800± foot long road will be constructed either on newly placed fill or the near-surface colluvial/residual soils as only minor cuts will be made to reach the proposed roadway subgrade. New compacted fill and thoroughly proof-rolled existing residual/colluvial soils will provide adequate pavement subgrade capable of providing a CBR value of 3 for pavement design.

Road 04

This road will traverse both the undisturbed hillside and the previously graded flat area from Station 0+00± to Station 10+00±. From Station 0+00 to Station 4+00±, the roadway will be constructed by making a cut that will be as deep as 25± feet near Station 2+00±. Consequently, the roadway subgrade will transition from residual soils to limestone bedrock back to residual soils. It might be preferred to overexcavate the bedrock by 3± feet when encountered and backfill with suitable on-site material to provide uniformly compressible subgrade for the pavement.

From Station 4+00± to Station 9+00±, the roadway alignment will require fill to raise the roadway grade. Beyond Station 9+00± and extending up to Station 16+00±, the roadway will be constructed by making a cut that will reach up to 50± feet deep in the vicinity of Station 11+50±. As

a result, the roadway subgrade will be comprised of both residual/colluvial soils and relatively incompressible medium hard to hard limestone and shale rock. The approximate limits of rocks are estimated to be Station 10+25± and 14+00±, a stretch of about 375 feet. As discussed under Road 02, it will be desirable to use the same pavement thickness everywhere to keep the uniformity of pavement despite much higher CBR value for rock. Construction of transition benches along the soil/rock contact should also be incorporated in the design to avoid stress construction due to abrupt change in the compressibility of subgrade materials. Installation of utilities will require excavation of hard rock along this section of roadway.

From Station 16+00± to the end of the road, new fill will be placed to raise the roadway grade. The fill is likely to consist of residual soils and extremely weathered rock, which when properly compacted will provide suitable pavement subgrade. A CBR value of 3 can also be used for this material.

Road 05

This is a relatively short road estimated to be about 560± feet long. The existing and proposed grades are such that only small cuts and fills will be needed to develop the desired roadway grade. Accordingly, the entire roadway pavement can be designed based on a CBR value of 3 that is representative of residual soils/compacted common fill.

Road 06

The first 200± feet of this 1200± foot long road will be constructed on a new fill that averages about 20± feet along the roadway centerline. Beyond Station 2+50±, the vertical alignment of the roadway essentially follows the existing ground surface elevation. As a result, only minor cuts in the range of 0± to 10± feet will be needed to reach the desired roadway grade. Considering the site is covered with an average soil thickness of 18± feet, the cut will be limited to the upper part of the soil zone for most of the roadway stretch. Accordingly, the pavement subgrade will be comprised of residual soils that will provide reasonably good pavement subgrade. Again, a CBR value of 3 should also be applicable for this road to calculate the pavement thickness.

6.0 GEOTECHNICAL DESIGN AND CONSTRUCTION CONSIDERATIONS

The geotechnical considerations at the Phase I area of the project site are controlled by the topography with its considerable relief across the site. To develop the buildable pads for the anticipated commercial and office buildings, deep cuts and high fills will be needed. The primary geotechnical considerations are as follows:

1. stability of cut slopes
2. stability of embankments
3. long-term total and differential settlements of fill embankments
4. foundation support systems for the buildings.

Each of these considerations is discussed below.

6.1 Slope Stability Analyses

A total of seven (7) sections, three (3) in the critical cut areas, three (3) at the highest embankment areas and one (1) where fill will be placed on top of cut, were selected for slope stability analyses. The analytical tool selected to conduct the analyses was a computerized slope stability program, *SLIDE2*, which was developed by RocScience. The results of the slope stability analyses are presented in Appendix D of this report. A summary of these analyses is presented below.

Selection of Shear Strength Parameters

The soil/rock parameters needed for the stability analyses consist of unit weight and effective shear strength parameters (cohesion and angle of internal friction) of both the in-place soil and rock material as well as anticipated fill material.

The shear strength parameters of the anticipated embankment and subsurface soils were selected based on the limited laboratory testing, SPT N-values, review of published literature and our experience on the similar materials. It is anticipated that the embankments will be constructed utilizing the soil mixed with some weathered rock that will become available from the excavations across the site. These materials will have a range of shear strength parameters, but for the stability analyses, an average value is selected to represent the entire fill mass. The parameters used in the slope stability are summarized in the following table:

Soil Type	Unit Weight (PCF)	Angle of Internal Friction (°)	Cohesion (PSF)
Existing Fill (CL)	120	26	50
Colluvial (CL)*	120	23	0
Residual (CL)	125	28	100
Coal/Carbonaceous Shale	130	30	100
Decomposed Shale (CL/SC)	130	32	100
Decomposed Sandstone/Limestone (GM/GC/SC)	135	34	100
Bedrock	150	40	3000
New Fill	130	30	150
Rock Toe	115	38	0

*Derived from soils/rock other than claystone

6.2 Stability of Cut Slopes

The cut slopes are located in Areas 1, 3, 5 and 6 (see Sheet No. 1 in Appendix C) with the deepest depicted on Geologic Cross-Sections A-A, F-F, L-L, M-M, O-O, P-P, Q-Q and R-R.

6.2.1 Area 1

The critical cut in Area 1 is depicted on Geologic Cross-Section A-A and extends from elevation 1233± to elevation 1190±, a depth of 43± feet. According to the cross-section, the soil zone will extend to a depth of 25± feet along the cut slope face, and the remaining cut face will be comprised of rock. The upper 7± feet of the soil zone consist of coal and carbonaceous shale and the remainder of the soil zone comprised of decomposed shale bedrock with very high SPT N-values. Since the soil zone has lower shear strength compared to the underlying bedrock, the potential failure zone is likely to be confined to the soil zone.

The results of the stability analyses indicate that the factor of safety (FS) against slope failure for the cut through the soil zone with 2H:1V slope ratio is 1.78 which is greater than the state-of-the-art required value of 1.5. The results of the stability analyses are included in Appendix D of this report. It may be pointed out that there may be isolated seepage coming from the coal seam. At

the top of the cut, slope treatment may be required to collect the seepage and channel it out to avoid slope erosion.

6.2.2 Area 3

The critical cut in Area 3 is depicted on Geologic Cross-Sections F-F and extends from elevation 1227± to elevation 1182±, a depth of 45± feet. According to the geologic cross-section, the entire cut slope will be confined to the soil zone. The upper 3± feet of the soil zone consists of colluvium with a 9± foot silty clay upper residual soil layer underlying it. The remainder of the soil zone along the cut slope face consists of a granular silty to clayey sand layer, which is essentially the badly decomposed underlying parent bedrock. While the colluvial soil has low shear strength, this layer is so thin that it will have very limited impact on the design of the cut slope. The residual soils have moderate to high shear strength and will allow for the cut to be safely made using a 2H:1V slope ratio. No slope stability analysis was performed on this section; however, based on previous experience with this type of soil, the factor of safety of this cut slope is expected to be greater than 1.5. It should be noted that a coal/carbonaceous shale seam was encountered midway down the slope face and isolated seepage may be encountered from this layer, which may require slope treatment to avoid erosion.

6.2.3 Area 5

The critical cuts in Area 5 are depicted on Geologic Cross-Sections P-P, Q-Q and R-R. The cut at Geologic Cross-Section P-P extends from elevation 1300± to 1268±, a depth of 33± feet. This cut is located along the backside of the north cut slope which was a part of the initial 2012 development phase. The soil mantle within this cut slope extends to a depth of 10± along the face of the cut and consists of very dense residual soils with relatively high shear strength that are essentially a decomposed sandstone bedrock. The remainder of the cut face will be through bedrock consisting of silty shale and limestone rock units, all with high shear strength that are capable of providing a safe cut using 2H:1V slope ratio. Therefore, no slope stability analysis was performed on this geologic cross-section. It should be noted that isolated seepage may be encountered from the coal/carbonaceous shale and limestone layers towards the bottom of the slope, which may require slope treatment to avoid erosion.

The other critical cut represented by Geologic Cross-Section Q-Q extends from elevation 1315± to 1272± feet, a depth of 43± feet. The soil cover at this cut is approximately 10± to 15± feet thick and is comprised of granular clayey sand. The upper residual soil layer has a loose relative density due to the proximity to the surface where weathering is more intensive while the lower residual soil layer is rich in more decomposed sandstone rock fragments. Both layers have moderately high shear strength. The reminder of the cut will be constructed through bedrock, mainly sandstone, with some carbonaceous shale/coal and limestone near the toe. Again, considering that majority of the cut slope will be confined to the high strength bedrock and the cut slope ratio will be 2H:1V, no slope stability analysis was performed at this location. Once again, isolated seepage may be encountered at the slope surface in the coal/carbonaceous shale and limestone layers at the toe but nothing serious enough to affect the long-term stability of the cut slope.

The critical cut at Geologic Cross-Section R-R extends from elevation 1257± to 1230± feet, a depth of 27± feet. Due to extensive weathering, the residual soil zone is about 20 feet thick at this location. With a 2H:1V slope ratio, the entire cut slope will be confined to the soil zone. The upper 3± feet of the soil zone consists of colluvial silty clay material. Although this material typically has very low shear strength, considering its proximity to the top where the cut will be rounded to a flatter slope, it is unlikely to have a negative impact on the overall stability of the cut. The residual soil consists of an upper layer of fine-grained silty clay with stiff consistency, followed by a 5± foot thick weathered coal/carbonaceous shale seam and a 7± foot layer of a decomposed shale with medium dense to very dense relative density. The residual soils have moderate to high overall shear strength as indicated by their composition and SPT N-values.

The results of the stability analyses, which are documented in Appendix D of this report, indicate that the factor of safety (FS) against slope failure for the 2H:1V cut through the soil zone is 1.51, which is greater than the industry-accepted value of 1.5. It may be pointed out that there may be isolated seepage coming from the coal seam along the slope face after the initial cut and during times of heavy precipitation and may require treatment.

6.2.4 Area 6

The critical cut in Area 6 is represented by Geologic Cross-Section M-M that extends from elevation 1190± to 1162± feet, a depth of 28± feet. The soil profile along the face of the cut

consists of 3± feet of silty clay colluvial soil at the top of the cut, followed by 15± feet of residual silty clay beneath that, and finally 15± feet of granular clayey sand at the bottom above the bedrock. The colluvial soils have a medium stiff consistency with low shear strength; however, due to their close proximity to the top of the slope where the cut will be rounded off to a flatter slope, they will have very little impact on the long-term stability of the cut. The upper silty clay residual soils have a stiff to hard consistency and have moderately high shear strength while the lower residual soils are essentially a decomposed shale bedrock with a very dense relative density and high shear strength.

The results of the stability analyses included in Appendix D of this report indicate that the factor of safety (FS) against slope failure for the cut with 2H:1V slope ratio through the soil zone is 1577, which is greater than the state-of-the-art requirement of 1.5.

6.3 Stability of Fill Embankment Over Cut Slope

The critical areas where fill embankments will be constructed over cut slopes are depicted on Geologic Cross-Sections L-L and O-O, which overlap areas 3 and 5 and 5 and 6, respectively. Geologic Cross-Section L-L was considered more critical of the two (2) areas and was selected for slope stability analyses. This section represents the subsurface conditions where new fill will be placed on top of the proposed cut slope. The cut portion of Geologic Cross-Section L-L extends from elevation 1227± to 1187± feet, a depth of 40± feet. Additionally, 30± feet of new fill will be placed directly overtop the cut slope at a 2H:1V slope ratio up to elevation 1257± feet to create a buildable pad at the top of slope. This will result in an overall slope face of about 70± feet. The soil profile along the cut/fill slope consists of 3± to 9± feet of silty clay colluvial soil, followed by 9± feet of silty clay residual soil which also contains two (2) distinct coal seams, and finally 2± to 7± feet of granular silty clay to clayey gravel residual soil, which is a decomposed claystone/limestone rock mix.

The colluvial soils have low shear strength while the residual soils have moderate to high shear strength. Slope stability analyses performed at this location indicate that a rock toe bench (10’ deep x 15’ wide) will need to be constructed at the cut/fill transition line and extend back to competent bedrock in order for this slope to meet the required 1.5 FS against slope failure. The results of the slope stability analyses are included in Appendix D of this report.

The cut portion of Geologic Cross-Section O-O extends from elevation 1225± to 1180± feet, a depth of 45± feet. Additionally, 20± feet of new fill will be placed directly overtop the cut slope at a 2H:1V slope ratio up to elevation 1245± feet to create a buildable pad at the top of slope resulting in an overall slope of 65± feet. The soil profile along the cut/fill slope consists of 3± to 6± feet of silty clay colluvial soil, followed by 3 to 6± feet of silty clay residual soil, and finally 5± to 15± feet of granular silty to clayey sand and gravel residual soil. The colluvial soils have low shear strength while the residual soils have moderate to high shear strength.

It is obvious from the analyses conducted at Geologic Cross-Section L-L that a similar treatment will be needed at the cut/fill slope represented by Geologic Cross-Section O-O. It is estimated a rock toe bench will be required at the cut/fill transition zone that would extend back to the more competent highly weathered rock zone (approximately 25± feet wide by 8± feet deep) to create a stable slope of 2H:1V cut/fill slope ratio.

6.4 Stability of Embankments

High embankments are proposed within Areas 1, 3, 4, and 5, primarily located along the south and west sides of the site. All embankments were designed with a 2H:1V slope geometry as indicated in the drawings prepared by Sheffler and Company, Inc.. Detailed slope stability analyses were conducted for each area and the results of the analyses have been documented in Appendix D of this report.

6.4.1 Area 1

One moderately high embankment is proposed within this area and the subsurface conditions at the greatest height of the embankment are depicted on Geologic Cross-Section B-B. The proposed fill embankment would extend from elevation 1108± to elevation 1155± feet, a height of 47± feet. The subgrade soils on which the embankment will be constructed consist of both residual and colluvial soils. The upper part of the residual soils typically has low shear strength due to weathering over time and thus the upper few feet (typically 2± to 3± feet) of these soils would be removed by constructing bonding benches to provide a firm base for the embankment. Due to their considerable height, the embankments will have to incorporate rock toe benches in order to create high strength

material and to provide a porous drainage medium at the toe to achieve the desired long-term stability. The bonding benches must be deep enough to key-in the new fill into competent material.

It is also recognized that underdrains in properly located bonding benches and bleeder trenches in the rock toe bench will be installed to collect and channel out ground water, depress the phreatic surface within the embankment and minimize saturation of fill. Therefore, these subgrade improvements are incorporated in the stability model.

The results of the slope stability analyses are presented in Appendix D and are summarized below.

Geologic Cross-Section	Rock Toe Dimensions (ft.)		Factor of Safety
	Depth	Width	
B-B	10	20	1.59

The results indicate that the proposed 2H:1V slope can safely be constructed of common fill with effective angle of internal friction, ϕ = 30 degrees and a nominal cohesion c = 150 PSF. The calculated factor of safety 1.59 against a slope failure is greater than the acceptable value of 1.5 provided proper subgrade modification and incorporation of rock toe bench and bonding benches are included in the design.

6.4.2 Area 3

The subsurface conditions at the main embankment along the northwest corner of the site are depicted by Geologic Cross-Sections G-G, H-H, and J-J. The embankment height ranges from 40± feet at Geologic Cross-Section J-J to 60± at Geologic Cross-Section H-H. The subgrade soils on which this embankment will be constructed consist primarily of colluvial and residual soils. Similar to Area 1, the upper part of the residual soils along with the colluvial soils typically have low shear strength due to weathering over time and thus the upper few feet (typically 2± to 3± feet) of these soils would be removed by constructing bonding benches to provide a firm base for the embankment. Additionally, the low strength colluvial soils located at the toe of the proposed embankment will be removed during the construction of the rock toe. Therefore, these soils will not have any impact on the stability of the embankment.

The subsurface conditions at the secondary embankment located more further north in the previously developed area are illustrated on Geologic Cross-Section K-K. This embankment will rise from elevation 1170± to 1235± feet, a height of 35± feet. The subgrade soils on which the embankment will be constructed consist of existing fill and the underlying residual soils. The low strength fill soils, located at the toe of the embankment, will be removed during construction of the rock toe while the moderately high strength residual soils are fairly competent into which bonding benches will be constructed. For slope stability analyses, Geologic Cross-Section J-J was selected as a slope stability model.

The results of the slope stability analyses are presented in Appendix D and are summarized in the table below that also lists the depth and width of rock toe benches at the four (4) geologic cross-sections.

Geologic Cross-Section	Rock Toe Dimensions (ft.)		Factor of Safety
	Depth	Width	
G-G	15	10	
H-H	10	10	
J-J	10	15	1.62
K-K	10	15	

Based on the above analyses, it is determined that the embankments at Area 3 can safely be constructed at a slope ratio of 2H:1V by providing adequately-sized rock toe benches extending into bedrock that will be available at a readily accessible depth of 10 to 15± feet and bonding benches extending below the low strength fill and colluvial soil zones.

6.4.3 Area 4

The subsurface conditions at the highest embankment in Area 4 are graphically depicted by Geologic Cross-Section I-I. This embankment will rise from toe elevation 1185± to top elevation 1215± feet, a height of 30± feet. The subgrade soils on which this embankment will be constructed consists primarily of colluvial and residual soils. As previously stated, the colluvial soils typically have low shear strength thus the upper few feet (typically 2± to 3± feet) of these soils would be removed by constructing bonding benches to provide a firm base for the embankment.

Additionally, the colluvial soils located at the toe of the proposed embankment will be removed during the construction of the rock toe bench. The depth to bedrock at this location is approximately 20 feet, thus the rock toe will bear in competent residual soils comprised of highly weathered rock.

The results of the slope stability analyses along Geologic Cross-Section I-I are presented in Appendix D and are summarized below.

Geologic Cross-Section	Rock Toe Dimensions (ft.)		Factor of Safety
	Depth	Width	
I-I	10	15	1.68

The results indicate that the proposed 2H:1V slope to be constructed of common fill from a mixture of onsite soil and weathered rock should provide a minimum required factor of safety value greater than 1.5 with proper subgrade modification including incorporation of a rock toe bench, bonding benches and underdrains.

6.4.4 Area 5

The subsurface conditions at the main embankment in Area 5 are plotted on Geologic Cross-Section S-S. The elevation near the toe of the embankment is 1203± feet. The top of embankment will be at elevation 1238± feet, a height of 35± feet. The subgrade soils on which this embankment will be constructed consist primarily of man-made fill and residual soils. As previously stated, the fill and upper residual soils typically have low shear strength, thus the upper few feet (typically 2± to 3± feet) of these soils would be removed by constructing bonding benches to provide a firm base for the embankment. The low strength fill and residual soils at the toe will be removed during construction of the rock toe bench, which will bear in competent limestone bedrock at this location.

It is obvious from the analyses conducted at the other fill embankments that a similar treatment will be needed at the slope represented by Geologic Cross-Section S-S, thus no slope stability analysis was performed at this location. It is estimated a rock toe bench will be required at the toe of slope that would extend back to the more competent highly weathered rock zone (approximately 15± feet wide by 15± feet deep) to create a stable slope of 2H:1V slope ratio.

6.4.5 Area 6

The subsurface conditions at the main embankment in Area 6 are plotted on Geologic Cross-Section N-N. The elevation near the toe of the embankment is 1110± feet. The top of embankment will be at elevation 1150± feet, a height of 40± feet. The subgrade soils on which this embankment will be constructed consist entirely of residual soils with the upper few feet (typically 2± to 3± feet) of these soils being removed by constructing bonding benches to provide a firm base for the embankment. The rock toe bench will bear in competent decomposed sandstone residual soils or sandstone bedrock at this location.

It is obvious from the analyses conducted at the other fill embankments that a similar treatment will be needed at the slope represented by Geologic Cross-Section N-N, thus no slope stability analysis was performed. It is estimated a rock toe bench will be required at the toe of slope that would extend back to the more competent highly weathered rock zone (approximately 15± feet wide by 10± feet deep) to create a stable slope of 2H:1V slope ratio.

6.5 Total and Differential Settlement of Embankments

In parts of the site where the large fill embankments will be constructed, a considerable amount of post-construction settlement can be expected, which will be contributed by the following three (3) components:

a. consolidation of existing soil under the weight of the fill;
b. long-term post construction consolidation of fill under self mass; and
c. consolidation of the soils due to the building loads.

Typically, the settlement resulting from the consolidation of 10 to 20± feet of existing soil zone is mostly completed by the time the fill is topped provided, the fill is placed over a period of 3 to 4± months. The settlement resulting from the post-construction consolidation of fill under self mass may take 3 to 6± months depending upon the thickness of the fill, its composition and the rate at which the embankment is constructed. For embankments constructed using common fill (on-site soil) the post-construction consolidation is generally in the range of 0.5 percent of the fill thickness. For granular fill consisting of ripped rock, the settlement decreases to about 0.25 percent of the fill thickness. Additionally, the rate of settlement in rock fill also increases compared to that of clayey soil fill.

The third component of settlement is caused by the building loads. Most buildings are designed to tolerate 1 inch and ¾ inch total and differential settlements. The properly engineered fill is capable of providing 2 to 3 KSF net allowable bearing material depending upon the type of fill material and limit the associated settlements to the designed criteria as long as the long-term settlement due to the post-construction consolidation of fill has been completed. Therefore, it is essential that a "rest/waiting" period be allowed for the embankments to mostly complete their post-construction consolidation prior to the construction of the structures. There are some avenues available to accelerate the rate of consolidation such use of surcharge or inclusion of free draining blankets sandwiched between the common fill at suitable intervals (typically 10 to 15± feet apart). However, any one of these options utilized has the associated costs. The decision to utilize these options is influenced by the project economics and construction schedule. It will be highly desirable to instrument and monitor the settlement behavior of the high embankments to facilitate the construction schedule.

6.6 Foundation Support Systems

At this time, it is assumed that the proposed buildings at the site will be lightly loaded structures such as 2 to 3-story wood-frame townhouses and single-family dwellings. Although no site-specific subsurface information had been collected at individual building locations, based on the limited available data the following general guidelines can be used for the preliminary design purposes followed by the supplementary investigations at each structure. The supplementary investigation should follow the geotechnical requirements of the future tenants/owners.

Lightly loaded structures placed exclusively in rock could be supported by shallow foundations bearing in rock using 4 to 15 TSF allowable bearing capacity depending on the rock lithology. Lightly to moderately loaded buildings located exclusively in the new engineered fill can be supported by shallow foundations bearing in fill. The available bearing capacity will range between 2 and 3 KSF for finer grained and granular material, respectively. The building located partially in soil and partially in rock may require either undercutting of rock and backfilling with compacted fill or lowering of footings in the soil zone to maintain similar compressible subgrade. In some cases, undercutting of soil and backfilling with lean concrete may become a better option.

7.0 RECOMMENDATIONS

Based on the discussion and evaluation of subsurface conditions presented in the previous sections GeoMechanics, Inc. presents the following recommendations for the Meadows Landing site development in South Strabane Township, Washington County, Pennsylvania.

7.1 Fill Embankments

7.1.1 Slope Ratio

- Design all fill embankment consisting of properly compacted common fill using a slope ratio not steeper than 2H:1V.

7.1.2 Embankment Subgrade Preparation

- Grub the area, remove all topsoil and any soft zones that may exist in the natural soil or previously placed fill at the subgrade level. The depth of unsuitable soil removal shall be adjusted based on the results of proof-rolling.

- Construct the rock toe benches and the upslope bonding benches of adequate dimensions to key the new fill into competent rock or residual soils.

- Locations of the rock toe bench and bonding benches are shown on the attached Site Plan, Sheet No. 1 included in Appendix E of this report. Typical subgrade treatment cross-sections, showing the approximate anticipated extent of the rock toe bench and bonding benches, are also presented in Appendix E, Sheet Nos. 2 through 13.

- The sizing of the rock toe benches is based on results of slope stability analyses and also the following general guidelines:

Height of Embankment (ft.)	Toe Dimensions	
	Width (ft.)	Depth (ft.)
50 to 90	20-40	10-20
35 to 50	15-20	10-15
20 to 35	10	10
10 to 20	10	6
0 to 10	10	3

- Extend the rock toe bench a minimum of 1 foot into competent bedrock, if bedrock is found to be shallower than the specified depth of rock toe bench. Build the rock toe bench on top of bedrock to the original design depth, or to a depth determined by the Engineer.

- Increase the depth of rock toe bench if competent subgrade is not available at the designed depth of rock toe. If any soft, wet clayey zone or decomposed coal seam is encountered at the bottom of rock toe during the construction, consider extending the rock toe below the soft clayey zone, as determined by the Engineer.

- Provide parallel bonding benches extending into competent material where fill is to be placed against the sloping hillside to key the new fill into in-situ competent residual soils or bedrock, as shown on the typical plan and embankment cross-sections. The dimensions of these benches will vary and may have to be adjusted in the field depending on the topography and slope of the hillside. In general, the depth and width of bonding benches will be 4 to 8± feet and 20 to 40± feet, respectively, depending on the slope of existing ground surface and thickness of proposed fill. All benches should start at a depth of at least 5 feet into competent residual soils below a depth of 3 feet from existing ground surface. See the Typical Embankment Cross-Sections on Sheet Nos. 2 through 14 in Appendix E.

- Provide a base drain at the bottom of gullies to collect seepage water from the gulley walls and channel it out through the toe bench drain for typical detail see Detail 1 included in Appendix F.

- Provide an underdrain in every 3rd bench to collect ground water that may be seeping out of the hillside (see Detail 2 in Appendix F). Provide sufficient gradient to allow the collected ground water to channel out on either side of the embankment or to the base drain located in the gulley bottom.

- Provide bleeder trenches every 300± feet laterally to provide an outlet for the ground water collected in the toe bench. For typical detail see Detail 2 in Appendix F of this report.

7.1.3 General Fill Placement

Common Fill

- Make excavations for installing bonding benches and rock toes within the competent residual soils and/or bedrock. Prior to placing any new fill, thoroughly proof-roll and compact the exposed subgrade using heavy earthmoving equipment (such as a 20-ton loaded triaxial dump truck, or a smooth drum vibratory roller which imparts a dynamic force of at least 300 pounds per lineal inch of drum length) until no perceptible movement is observed or to the satisfaction of the engineer. If any wet, soft or yielding soils are detected by proof-rolling, and which cannot be stabilized with additional compaction, they should be undercut to stable material. The expected depth of additional undercutting is typically 2 to 3± feet below the stripped subgrade, however, it should be adjusted based on actual subgrade conditions. Backfilling must be performed with dry and granular material under proper compaction control. Proof-rolling should not be performed when the subgrade is wet or frozen and when bedrock is present.

- Samples of the common fill material should be collected and tested prior to the site work to determine the maximum dry density, optimum moisture content, gradation and plasticity characteristics. These tests are necessary to control the quality of the fill material and determine the controlling

parameters for field compaction. The on-site excavated material could be used as new fill provided it is properly blended and moisture conditioned. However, excessively clayey material (claystone) or other deleterious materials must not be used as fill.

- Periodically test the floor slab or pavement subgrade material (both the in-place material and/or new fill) for the presence of expansive pyritic material, as determined by the inspectors during the pad preparation. If any expansive material is detected or suspected within a 5 feet depth of the bottom of floor slab or bottom of the foundation, such pyritic materials must be removed from the affected areas and replaced with suitable inert materials.

- Remove all large cobbles and boulders greater than 6 inches in maximum dimension, which may interfere with the rolling and compaction of the embankment material.

- Place and compact the common fill in maximum 9-inch thick loose layers; compact each layer to 95 percent of the maximum dry density at ±2 percent of the optimum moisture content as determined by the Modified Proctor Compaction test (ASTM: D 1557). In confined areas, use a smaller compactor and reduce the lift thickness to 6 inches. Care should be exercised to ensure that the fill is free from excessively clayey or any organic-rich materials. Particles larger than 3 inches in maximum dimension should not be included in the upper 5 feet of engineered fill placed within the building area. Larger rock pieces, mixed with other soils and rock debris, can be placed within the deeper part of the fill outside of the building pads.

- Maintain the embankment in a satisfactory manner until final completion of the project. Replace any or all sections which become damaged or displaced due to any construction activities or natural causes, such as rain or snow storms, etc.

Rock Fill

- The rock toe bench must be constructed of hard, durable sandstone and/or limestone rock. Sufficient amount of hard rock is expected to be available from the on-site cut areas and, therefore, it should not be necessary to import rock materials. The maximum size of rock material shall not exceed 12 inches and should be free of fines (-#200 sieve maximum 5%). Other degradable material such as soft shale/claystone, fissile silty clayey or sandy shale or siltstone must not be used as rock fill material, in place of hard and durable sandstone and limestone. The lift thickness should not exceed 18 inches. Alternatively, sound and durable crushed concrete or any other free draining material such as hard heavier slag (minimum unit weight of 125 PCF can be used in toe bench).

- Compact the rock used in the toe bench with a smooth steel drum vibratory-type roller using a minimum static weight of 10 tons, capable of delivering a dynamic force of at least 300 pounds per lineal inch of drum length. Perform rolling until a no-movement condition is achieved, but apply a minimum of four (4) overlapping passes of the roller, and as directed by the Engineer.

7.2 Cut Slope

Slope Ratio

- Design all cuts confined to the soil using a maximum of 2H:1V slope ratio with rounding at the top.

- Design all cuts extending through the rock no steeper than 1.5H:1V.

Rock Excavation

- Use mechanical equipment to perform excavations into bedrock. While most of the rock is rippable, some sandstone and limestone intervals are

massive and hard. Use pre-splitting and hoe ramming to excavate these rock units. Alternatively use controlled blasting to excavate these rock units.

Erosion Control

- Provide diversion ditches at the top of cut, approximately five feet beyond the cut face to collect the surface runoff from the upslope area and channel it out to minimize erosion of the cut face.

- Provide a collector trench near the toe of the cut to control the surface runoff and tie it to the nearest storm water management inlet.

- Provide an impermeable clay liner in the diversion ditch. This will prevent seepage of water into the subsurface soils and avoid slope instability.

7.3 Pavement Design

No daily ESAL's values are available for this project. However, based on GeoMechanics, Inc.'s experience with similar type of projects the following asphalt pavement thicknesses for the pavement of the proposed roadway, overlying a Mirafi 600X fabric, are recommended. A CBR of 3 was assumed for the newly placed fill and subgrade materials based on the two (2) laboratory CBR tests. The pavement thicknesses presented below are based on an assumed ESAL value. When anticipated traffic data becomes available for the development, the pavement design should be reevaluated to verify the recommended design is adequate for the intensity of the traffic loads.

Course (PENNDOT 408 Specification Section)	Flexible Pavement
Wearing Course ID-2, 420	1.5"
Binder Course ID-2, 421	3.5"
Base Course, AASHTO #57	9.0"
Total Thickness	14.0"

- Use a compacted coarse aggregate, equivalent to AASHTO No. 57. Alternatively, use AASHTO No. 1 or No. 3 crushed stone. The open graded stone should be "surface choked" with minus fractional material such as PENNDOT No. 2A. The surface material should be compacted with at least two (2) passes of a smooth-drum steel wheeled roller with a minimum weight of 10 tons.

- Proof-roll thoroughly the soil/fill surface before the base course is placed. If a soft and yielding spot is encountered, excavate the soft material and backfill with properly compacted dry material.

- Tie the base course into side drainage ditches as well as storm water inlets to provide positive drainage.

- When bedrock is encountered at pavement subgrade elevation, construct a transition bench as shown in Detail 4 of Appendix F. Backfill the transition bench using properly compacted PENNDOT 2A coarse aggregate.

7.4 Preliminary Type and Depth of Foundations

According to the current grading plan, the foundation materials available for support of a shallow foundation vary from engineered fill to residual soils to bedrock. All foundations for a respective building should bear in similar foundation materials, in regards to compressibility.

- In the event dissimilar materials are encountered at the bearing elevation for shallow foundations, any existing bedrock will need to be undercut and backfilled with inert material under compaction control.

- Use a net allowable soil pressure of 2.0 KSF and a maximum toe pressure of 2.8 KSF to size footings, bearing both in residual soils and engineered fill.

- Use a minimum width of 18 inches for strip footings and 36 inches for spread footings regardless of bearing pressure to properly distribute the load and minimize the potential for local or 'punching' shear.

- Place footings, exposed to outside weather, at least 42 inches below the outside finished grade to protect foundations from frost heaving. The interior footings, however, could be placed at shallower depths but in similar competent subgrade.

7.5 Testing and Monitoring

- Have a geotechnical engineer or experienced soils technician from GMI at the site to inspect and ensure the placement and compaction of the fill, the excavation procedures; installation of rock toe and bonding benches and underdrains in compliance with the job specification. The duties also include inspection of building foundations, floor slabs, pavement and the reinforced walls to ensure that the bearing materials are compatible with the design criteria set forth in this report and comply with the applicable specifications.

- Schedule a waiting period of sufficient length (typically 4 to 6 months) to allow settlement of the fill embankments prior to placing the foundation and the pavement. Implement a comprehensive settlement monitoring program to determine the time rate of settlement. Install a sufficient number of settlement monitoring devices (see Detail 3 in Appendix F) where high fills will be placed to monitor the settlement and adjust the construction schedule accordingly. The number and location of settlement monitoring devices should be finalized, when the grading plans are finalized and construction is nearing a start.

- Perform surveys on the settlement monitoring devices to estimate both the total settlement and the rate of settlement of the compacted fill. Record both

the vertical and horizontal movements. The data on the settlement monitoring devices should be made available to GeoMechanics, Inc. immediately so that the data can be plotted to assess the time-settlement behavior of the fill embankments and to decide when the settlement has stabilized and construction can be started.

- If scheduling constraints require the use of shorter time for consolidation of fill, consider using a minimum 20± feet high embankment surcharge load under the building area. The height and duration of the embankment surcharge will depend on the desired consolidation time. The use of a surcharge may shorten the time for consolidation of fill, but it cannot be eliminated completely. In addition, this will increase the cost significantly.

- Install slope inclinometers at high embankments to monitor the deformation behavior of the embankments, to detect the presence of any slippage (excessive shear movement) within the embankments and, if needed, develop corrective methods. The number and location of inclinometers should be finalized, when the fill placement is nearing completion.

7.6 Limitations

- The subsurface evaluation of the site is based on a limited number of borings spread across a large area. Considerable extrapolation among borings was needed to prepare the generalized geologic cross-sections. The recommendations presented in this report are general in nature and should be modified, if necessary, based on the actual field data.

- During the site preparation and construction, if subsurface conditions encountered differ significantly from those reported herein, this office should be notified immediately so that the analyses and recommendations can be reviewed and/or revised accordingly.

- This report has been prepared in accordance with the generally accepted engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. We assume no responsibility for interpretations made by others based upon work or evaluation made by GeoMechanics, Inc.

- In preparing this report, the only warranty or guarantee made by GeoMechanics, Inc. in connection with services performed for this project is that such services were performed with the care and skill ordinarily exercised by reputable members of the profession practicing under similar conditions at the same time and the same or similar locality. No other warranty, expressed or implied, is made or intended by rendition of these consulting services or by furnishing oral or written reports of the findings made.

TABLES

TABLE NO. 1A:
SUMMARY OF PERTINENT BORING INFORMATION (SOIL AND GROUNDWATER)
(Page 1 of 2)

Boring No.	Exsisting Elevation (ft.)	Total Depth (ft.)	Geologic Cross-Section	Proposed Grade (ft.)	*Soil*																Total Soil Thick-ness (ft.)	*Groundwater*			
					Fill				*Colluvial / Alluvial*				*Upper Residual*				*Lower Residual*					*O-Hour*		*24-Hours*	
					Thick-ness (ft.)	USCS Class-ification	N_{av}	Base Elev. (ft.)	Thick-ness (ft.)	USCS Class-ification	N_{av}	Base Elev. (ft.)	Thick-ness (ft.)	USCS Class-ification	N_{av}	Base Elev. (ft.)	Thick-ness (ft.)	USCS Class-ification	N_{av}	Base Elev. (ft.)		Depth (ft.)	Elev. (ft.)	Depth (ft.)	Elev. (ft.)
2006 BORINGS																									
B-3	1315.0	21.7											5.0	cl	12	1310.0	16.7	sc	60	1293.3	21.7	Dry			
B-4	1220.0	15.6											11.5	sc	18	1208.5	4.1	sc	50 +	1204.4	15.6	Dry			
B-5	1235.0	40.0											4.0	cl	21	1231.0	9.2	sc	50 +	1321.8	13.2				
B-7	1255.0	60.0											10.0	cl	16	1245.0	15.0	sc	52	1230.0	25.0	25.0	1230.0		
B-8	1230.0	17.8											11.5	cl	18	1218.5	6.8	sc	50 +	1212.2	18.3	Dry			
B-9	1215.0	20.0											9.5	cl	23	1205.5	10.5	sc	34	1195.0	20.0	Dry			
2012 BORINGS																									
GB-5	1308.0	120.0	P-P	1200									8.0	**CL**	21	1300.0	7.1	cl	50 +	1292.9	15.1	88.2	1219.8		
GB-18	1174.6	38.0							9.0	**CL**	11	1165.6	6.0	gc	31	1159.6	15.0	sc,gm	50	1144.6	30.0	4.4	1170.2	13.2	1161.4
GB-19	1132.5	23.0	C-C	1212					3.0	cl	2	1129.5	3.0	cl	33	1126.5	9.4	sc coal	33 -50+	1117.1	15.4	2.8	1129.7	2.7	1129.8
GB-20	1124.9	23.0	D-D	1220					2.0	cl	8	1122.9	5.0	cl	14	1117.9	8.4	**SC**	50 +	1109.5	15.4	3.6	1121.3	6.9	1118.0
GB-21	1141.2	22.5	E-E										9.5	cl, sm (carb)	24	1131.7	5.0	sm	63 -50+	1126.7	14.5	4.8	1136.4	9.2	1132.0
GB-22	1154.3	35.0	E-E	1226					15.0	**CL**	11	1139.3					5.0	sm	78 -50+	1134.3	20.0	4.9	1149.4		
GB-23	1173.2	40.0	C-C	1212					9.5	**CL**	10	1163.7					6.2	sc	45	1157.5	15.7	5.7	1167.5	Caved 16.3'	
GB-24	1148.8	43.0	D-D	1220					12.0	**CL**	9	1136.8					6.0	sm	12	1130.8	18.0	19.1	1129.7		
GB-25	1170.6	32.5		1226									10.0	cl	12	1160.6	15.1	**GC**	46	1145.5	25.1	6.2	1164.4	9.2	1161.4
P-3	1114.6	15.4	N-N	1108									8.0	sc	14	1106.6	7.4	gm	50 +	1099.2	15.4	Dry			
P-4	1112.6	15.1		1108									10.0	cl	14	1102.6	5.1	gm	50 +	1097.5	15.1	Dry			
P-7	1115.8	21.0											12.0	cl	17	1103.8	3.4	sc	50 +	1100.4	15.4	2.7	1113.1	5.9	1109.9
P-8	1118.2	21.0											12.0	cl	17	1106.2	3.4	sc	50 +	1102.8	15.4	2.8	1115.4	5.5	1112.7

TABLE NO. 1A:
SUMMARY OF PERTINENT BORING INFORMATION (SOIL AND GROUNDWATER)
(Page 2 of 2)

Boring No.	Exsisting Elevation (ft.)	Total Depth (ft.)	Geologic Cross-Section	Proposed Grade (ft.)	Soil																Groundwater			
					Fill				Colluvial / Alluvial				Upper Residual				Lower Residual				Total Soil Thick-ness (ft.)	O-Hour		24-Hours	
					Thick-ness (ft.)	USCS Class-ification	N_{av}	Base Elev. (ft.)	Thick-ness (ft.)	USCS Class-ification	N_{av}	Base Elev. (ft.)	Thick-ness (ft.)	USCS Class-ification	N_{av}	Base Elev. (ft.)	Thick-ness (ft.)	USCS Class-ification	N_{av}	Base Elev. (ft.)		Depth (ft.)	Elev. (ft.)	Depth (ft.)	Elev. (ft.)
2021 BORINGS																									
TB-1	1234.4	41.5	A-A	1190								1234.4	10.0	sc	26	1224.4	21.0	sc,gc	50+	1203.4	31.0	22.7	1211.7	27.3	1207.1
TB-2	1233.0	19.0	A-A	1190									7.5	sc, **CL**	44	1225.5	11.5	sc	50+	1214.0	19.0	DRY		DRY	
TB-3	1107.6	17.0	B-B	1160									13.0	**CL**	13	1094.6	4.0	gm	50+	1090.6	17.0	DRY		DRY	
TB-4	1256.1	32.5	R-R	1230					3.0	**cl**	5	1253.1	12.0	cl, sm	26	1241.1	6.5	gc	30 -50+	1234.6	21.5	6.8	1249.3	7.2	1248.9
TB-5	1211.6	30.7	F-F	1182					3.0	cl	16	1208.6	6.5	**CL**	20	1202.1	21.2	sm, sc	13 -50+	1180.9	30.7	DRY		31.4	1180.2
TB-6	1203.0	12.6	S-S	1238	3.0	cl	7	1200.0				1200.0	6.5	**CL**	17	1193.5	3.1	gc	50+	1190.4	12.6	DRY		DRY	
TB-7	1112.3	10.0	H-H	1170									3.5	cl	19	1108.8	6.5	sm	17 -50+	1102.3	10.0	DRY		DRY	
TB-8	1116.7	15.1	G-G	1170									9.0	**CL**	12	1107.7	6.1	gc	13 -50+	1101.6	15.1	DRY		DRY	
TB-9	1185.1	19.4	I-I	1217					9.0	**CL**	17	1176.1	3.0	sc	16	1173.1	7.4	sc, gc	45 -50+	1165.7	19.4	DRY		10.2	1174.9
TB-10	1144.4	13.5	J-J	1185					7.5	**CL**	12	1136.9	4.5	sc	14	1132.4	1.5	gc	50+	1130.9	13.5	8.2	1136.2	7.6	1136.8
TB-11	1306.1	41.5	Q-Q	1272									4.0	sc	12	1302.1	5.6	gc	50+	1296.5	9.6	32.8	1273.3	CAVED DRY	
TB-12	1170.4	15.6	K-K	1205	3.0	cl	12	1167.4					6.0	cl, sc	25	1161.4	6.6	sc	56 -50+	1154.8	15.6	DRY		13.0	1157.4
TB-13	1230.2	17.0	L-L	1256					3.0	cl	6	1227.2	12.0	cl, sc, gc	15	1215.2	2.0	gc	56	1213.2	17.0	DRY		7.3	1222.9
TB-14	1213.8	25.2	L-L	1188					9.0	**CL**	10	1204.8	3.0	cl	10	1201.8	13.2	gc, cl	49 -50+	1188.6	25.2	DRY		DRY	
TB-15	1190.0	30.2	M-M	1162					3.0	cl	5	1187.0	15.0	**CL**	31	1172.0	12.2	sc	50+	1159.8	30.2	DRY		26.1	1163.9
TB-16	1226.9	11.0	O-O	1240					3.0	cl	7	1223.9	3.0	**cl**	10	1220.9	5.0	gc	16 -50+	1215.9	11.0	DRY		DRY	
TB-17	1204.7	25.5	O-O	1180					6.0	**CL**	8	1198.7	6.0	cl	16	1192.7	13.5	sc, gm	62 -50+	1179.2	25.5	DRY		DRY	
Averages					3.0		10	1183.7	6.5		10	1182.9	7.9		19	1181.9	8.5		35	1173.3	18.6	15.0	1169.8	12.2	1161.1

Total Drilling = 1001.9 feet

TABLE NO. 1B:
SUMMARY OF PERTINENT BORING INFORMATION (BEDROCK)

Bedrock

Boring No.	Exsisting Elevation (ft.)	Total Depth (ft.)	Geologic Cross-Section	Proposed Grade (ft.)	Est. Top of Rock Elev. (ft.)	Layer 1 Thick-ness (ft.)	Layer 1 Type of Bedrock	Layer 1 Core Recovery Length (ft.)	Layer 1 Core Recovery Percent (%)	Layer 1 RQD Length (ft.)	Layer 1 RQD Percent (%)	Layer 1 Base Elev. (ft.)	Layer 2 Thick-ness (ft.)	Layer 2 Type of Bedrock	Layer 2 Core Recovery Length (ft.)	Layer 2 Core Recovery Percent (%)	Layer 2 RQD Length (ft.)	Layer 2 RQD Percent (%)	Layer 2 Base Elev. (ft.)
2006 BORINGS																			
B-3	1315±	21.7			1293.3														
B-4	1220±	15.6			1204.4														
B-5	1235±	40.0			1221.8	11.0	Shale	9.4	86	4.0	36	1210.8	7.8	Shale	7.8	100	1.7	22	1203.0
B-7	1255±	60.0			1230.0	9.0	Shale	9.0	100	0.5	5	1223.0	13.7	Sandstone	137.0	90	2.3	17	1207.8
B-8	1230±	17.8			1212.2														
B-9	1215±	20.0			1195.0														
2012 BORINGS																			
GB-5	1308.0	120.0	D-D	1200	1292.9	16.9	Sandstone Shale	14.8	88	1.6	9	1276.0	4.6	Carb Shale	1.4	30	0.0	0	1271.4
GB-18	1174.6	38.0			1144.6	2.0	Limestone	1.7	85	0.0	0	1142.6	6.0	Claystone	5.6	93	0.0	0	1136.6
GB-19	1132.5	23.0	I-I	1212	1117.1	7.6	Siltstone	7.2	95	3.1	40	1109.5							
GB-20	1124.9	23.0	I-I	1220	1109.5	4.6	Carb Clayshale	4.2	91	2.2	47	1104.9	3.0	Limestone	3.0	100	1.3	44	1101.9
GB-21	1141.2	22.5			1126.7	0.8	Sandstone	0.8	100	0.4	52	1125.9	3.0	Coal	0.9	30	0.0	0	1122.9
GB-22	1154.3	35.0	J-J	1226	1134.3	6.5	Shale Clayshale	6.5	100	0.0	0	1127.8	1.5	Coal	1.5	100	0.0	0	1126.3
GB-23	1173.2	40.0	J-J	1212	1157.5	12.3	Sandstone Shale	11.7	95	5.5	45	1145.2	12.0	Claystone Limestone	12.0	100	6.0	50	1133.2
GB-24	1148.8	43.0	K-K	1220	1130.8	6.0	Sandstone Shale	4.6	77	1.7	28	1124.8	9.5	Carb Shale Coal	9.5	100	0.4	4	1115.3
GB-25	1170.6	32.5	K-K	1226	1145.5	7.4	Sandstone Shale	7.0	95	2.0	27	1138.1							
P-3	1114.6	15.4		1108	1099.2														
P-4	1112.6	15.1		1108	1097.5														
P-7	1115.8	21.0			1100.4	5.6	Sandstone w/ Shale	5.6	100	1.4	24	1094.8							
P-8	1118.2	21.0			1104.7	5.6	Sandstone w/ Shale	5.6	100	2.3	40	1099.1							

Boring No.	Layer 3 Thick-ness (ft.)	Layer 3 Type of Bedrock	Layer 3 Core Recovery Length (ft.)	Layer 3 Core Recovery Percent (%)	Layer 3 RQD Length (ft.)	Layer 3 RQD Percent (%)	Layer 3 Base Elev. (ft.)	Layer 4 Thick-ness (ft.)	Layer 4 Type of Bedrock	Layer 4 Core Recovery Length (ft.)	Layer 4 Core Recovery Percent (%)	Layer 4 RQD Length (ft.)	Layer 4 RQD Percent (%)	Layer 4 Base Elev. (ft.)
2006 BORINGS														
B-3														
B-4														
B-5	8.0	Siltstone	8.0	100	4.0	51	1195.0							
B-7	12.0	Siltstone	12.5	98	4.5	35	1170.0							
B-8														
B-9														
2012 BORINGS														
GB-5	22.4	Limestone Claystone	15.2	68	0.4	2	1249.0	7.0	Carb Shale Coal	6.5	93	0.0	0	1242.0
GB-18														
GB-19														
GB-20														
GB-21	4.2	Siltstone	4.0	95	2.7	63	1118.7							
GB-22	7.0	Siltstone	7.0	100	1.5	21	1119.3							
GB-23														
GB-24	9.5	Siltstone	9.5	100	5.3	56	1105.8							
GB-25														
P-3														
P-4														
P-7														
P-8														

Boring No.	Layer 5 Thick-ness (ft.)	Layer 5 Type of Bedrock	Layer 5 Core Recovery Length (ft.)	Layer 5 Core Recovery Percent (%)	Layer 5 RQD Length (ft.)	Layer 5 RQD Percent (%)	Layer 5 Base Elev. (ft.)	Layer 6 Thick-ness (ft.)	Layer 6 Type of Bedrock	Layer 6 Core Recovery Length (ft.)	Layer 6 Core Recovery Percent (%)	Layer 6 RQD Length (ft.)	Layer 6 RQD Percent (%)	Layer 6 Base Elev. (ft.)	Layer 7 Thick-ness (ft.)	Layer 7 Type of Bedrock	Layer 7 Core Recovery Length (ft.)	Layer 7 Core Recovery Percent (%)	Layer 7 RQD Length (ft.)	Layer 7 RQD Percent (%)	Layer 7 Base Elev. (ft.)
2006 BORINGS																					
B-3																					
B-4																					
B-5																					
B-7																					
B-8																					
B-9																					
2012 BORINGS																					
GB-5	28.5	Sandstone Shale	26.6	93	11.4	40	1213.5	13.3	Carb Shale CL, LM, SH	13.3	100	7.1	53	1200.2	12.2	Limestone Claystone	12.2	100	5.1	42	1188.0
GB-18																					
GB-19																					
GB-20																					
GB-21																					
GB-22																					
GB-23																					
GB-24																					
GB-25																					
P-3																					
P-4																					
P-7																					
P-8																					

TABLE NO. 1B:
SUMMARY OF PERTINENT BORING INFORMATION (BEDROCK)

Boring No.	Exsisting Elevation (ft.)	Total Depth (ft.)	Geologic Cross-Section	Proposed Grade (ft.)	***Bedrock***																				
					Est. Top of Rock Elev. (ft.)	*Layer 1*							*Layer 2*							*Layer 3*						
						Thick-ness (ft.)	Type of Bedrock	Core Recovery		RQD		Base Elev. (ft.)	Thick-ness (ft.)	Type of Bedrock	Core Recovery		RQD		Base Elev. (ft.)	Thick-ness (ft.)	Type of Bedrock	Core Recovery		RQD		Base Elev. (ft.)
								Length (ft.)	Percent (%)	Length (ft.)	Percent (%)				Length (ft.)	Percent (%)	Length (ft.)	Percent (%)				Length (ft.)	Percent (%)	Length (ft.)	Percent (%)	
2021 BORINGS																									
TB-1	1234.4	41.5	A-A	1190	1203.4	5.2	Siltstone	3.5	67	0.0	0	1198.2	5.3	Limestone	5.1	96	2.0	38	1192.9						
TB-2	1233.0	19.0	A-A	1190	1214.0																				
TB-3	1107.6	17.0	B-B	1160	1090.6																				
TB-4	1256.1	32.5	R-R	1230	1234.6	11.0	Siltstone/ Shale	11.0	100	0.0	0	1223.6													
TB-5	1211.6	30.7	F-F	1182	1180.9																				
TB-6	1203.0	12.6	S-S	1238	1190.4																				
TB-7	1112.3	10.0	H-H	1170	1102.3																				
TB-8	1116.7	15.1	G-G	1170	1101.6																				
TB-9	1185.1	19.4	I-I	1217	1165.7																				
TB-10	1144.4	13.5	J-J	1185	1130.9																				
TB-11	1306.1	41.5	Q-Q	1272	1296.5	13.2	Sandstone	13.2	100	2.8	21	1283.3	7.7	Carb Shale and Coal	4.8	62	0.0	0	1275.6	11.0	Limestone	2.6	24	2.1	19	1264.6
TB-12	1170.4	15.6	K-K	1205	1154.8																				
TB-13	1230.2	17.0	L-L	1256	1213.2																				
TB-14	1213.8	25.2	L-L	1188	1188.6																				
TB-15	1190.0	30.2	M-M	1162	1159.8																				
TB-16	1226.9	11.0	O-O	1240	1215.9																				
TB-17	1204.7	25.5	O-O	1180	1179.2																				

Total Drilling = 1001.9 feet

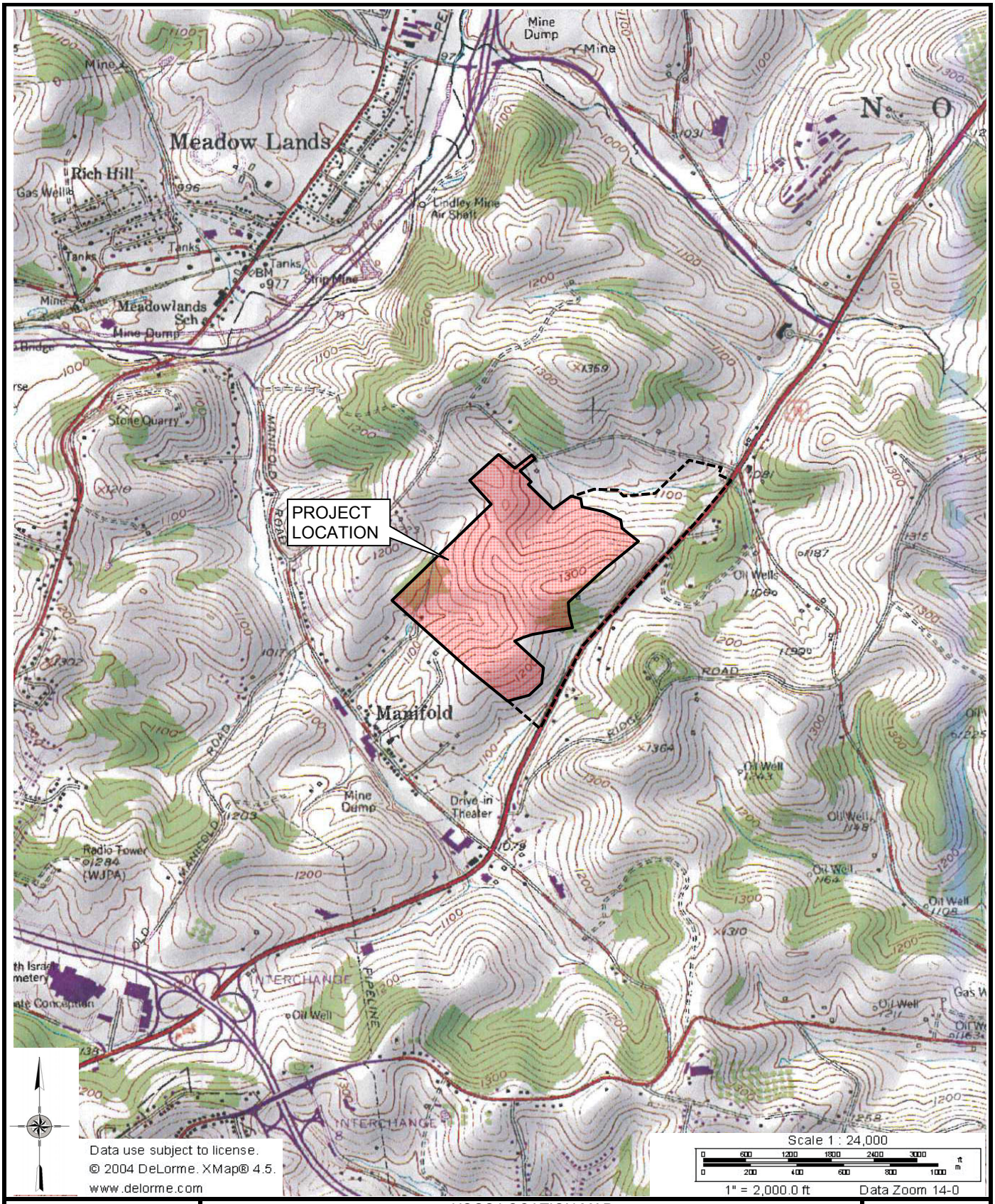
TABLE NO. 2

LABORATORY SOIL TESTING RESULTS

Boring	Sample Depth (ft)	Sample Type	Soil Origin	LABORATORY TEST RESULTS																		Frost Group	Description
				Atterberg Limits			Moisture	Gradation (%ASTM)					Soil Classification		Direct Shear			Compaction		CBR			
				L.L.	P.L.	P.I.	N.W.C. (%)	Gravel	Sand	Silt	Clay	<0.02 mm	AASHTO	USCS	ϕ (degrees)	Cohesion, c (psf)	Total Unit Weight (pcf)	Max Dry Density (PCF)	Optimum Moisture Content (%)	at 0.1 in. (%)	at 0.2 in. (%)		
2012 Lab Tests																							
GB-5	0.0 - 15.1	Jar	Residual	31	17	14	9.4	9	24	35	32	54	A-6(7)	CL	27.4	312	132.4					F3	Silty Clay, Some Sand, Trace Gravel, Damp
															Remolded								
GB-18	3.0 - 7.5	Jar	Colluvial	44	20	24	15.8	9	17	28	46	74	A-7-6(17)	CL								F3	Silty Clay, Little Sand Trace Gravel, Moist
GB-20	9.0 - 12.7	Jar	Residual	38	21	19	8.4	24	33	23	20	45	A-6(3)	SC								F2	Clayey Sand, Some Gravel, Some Silt, Damp
GB-22	9.0 - 13.5	Jar	Colluvial	31	18	13	13.9	22	28	31	19	50	A-6(3)	CL								F3	Silty Clay, Some Sand, Some Gravel, Damp
GB-23	3.0 - 7.5	Jar	Colluvial	49	25	24	22.5	7	19	33	41	74	A-7-6(18)	CL								F3	Silty Clay, Little Sand, Trace Gravel, Damp
GB-24	9.0 - 10.5	Shelby Tube	Colluvial	38	19	19	12.6	5	13	25	57	82	A-6(15)	CL								F3	Silty Clay, Little Sand, Trace Gravel, Damp
GB-25	12.0 - 16.5	Jar	Residual	37	21	16	16.3	31	28	22	19	41	A-6(3)	GC								F3	Clayey Gravel, Some Sand, Some Silt
2021 Lab Tests																							
TB-2	9.0-12.7	Jar	Residual	33	21	12	8.7	20	27	36	17	35	A-6(4)	CL								F3	Silty Clay, Some Sand, Some Gravel, Damp
TB-3	6.0-10.5	Jar	Residual	45	20	25	19.1	3	20	34	43	60	A-7-6(18)	CL								F3	Silty Clay, Some Sand, Trace Gravel, Moist
TB-5	3.0-12.0	Bag	Residual	34	17	17	7.3	2	19	36	44	67	A-6(12)	CL				123.7	12.7	4.3	4.5	F3	Silty Clay, Little Sand, Trace Gravel, Damp
TB-6	3.0-7.5	Jar	Residual	44	22	22	17.0	13	19	31	38	55	A-7-6(14)	CL								F3	Silty Clay, Little Sand, Little Gravel, Moist
TB-8	3.0-7.5	Jar	Residual	42	22	20	16.9	6	16	27	51	67	A-7-6(15)	CL								F3	Silty Clay, Little Sand, Trace Gravel, Moist
TB-9	3.0-7.5	Jar	Colluvial	36	20	16	14.6	10	21	43	27	47	A-6(9)	CL								F3	Silty Clay, Some Sand, Trace Gravel, Damp
TB-10	3.0-7.5	Jar	Colluvial	41	23	18	18.6	8	20	41	31	58	A-7-6(12)	CL								F3	Silty Clay, Some Sand, Trace Gravel, Moist
TB-14	3.0-7.5	Jar	Colluvial	46	23	23	18.2	15	21	27	38	54	A-7-6(13)	CL								F3	Silty Clay, Some Sand, Little Gravel, Damp
TB-15	3.0-18.0	Bag	Residual	34	18	16	4.7	4	26	32	38	57	A-6(9)	CL				127.3	10.4	2.4	2.6	F-3	Silty Clay, Some Sand. Trace Gravel, Dry
TB-17	0.0-4.5	Jar	Colluvial	49	22	27	21.3	3	8	34	56	78	A-7-6(26)	CL								F3	Silty Clay. Trace Sand, Trace Gravel, Moist

Not Performed

FIGURES



Date:	May 2021
Scale:	As Shown
Drn. By:	M.E.H.
Chk. By:	J.M.A.
Job No.	21016

USGS LOCATION MAP

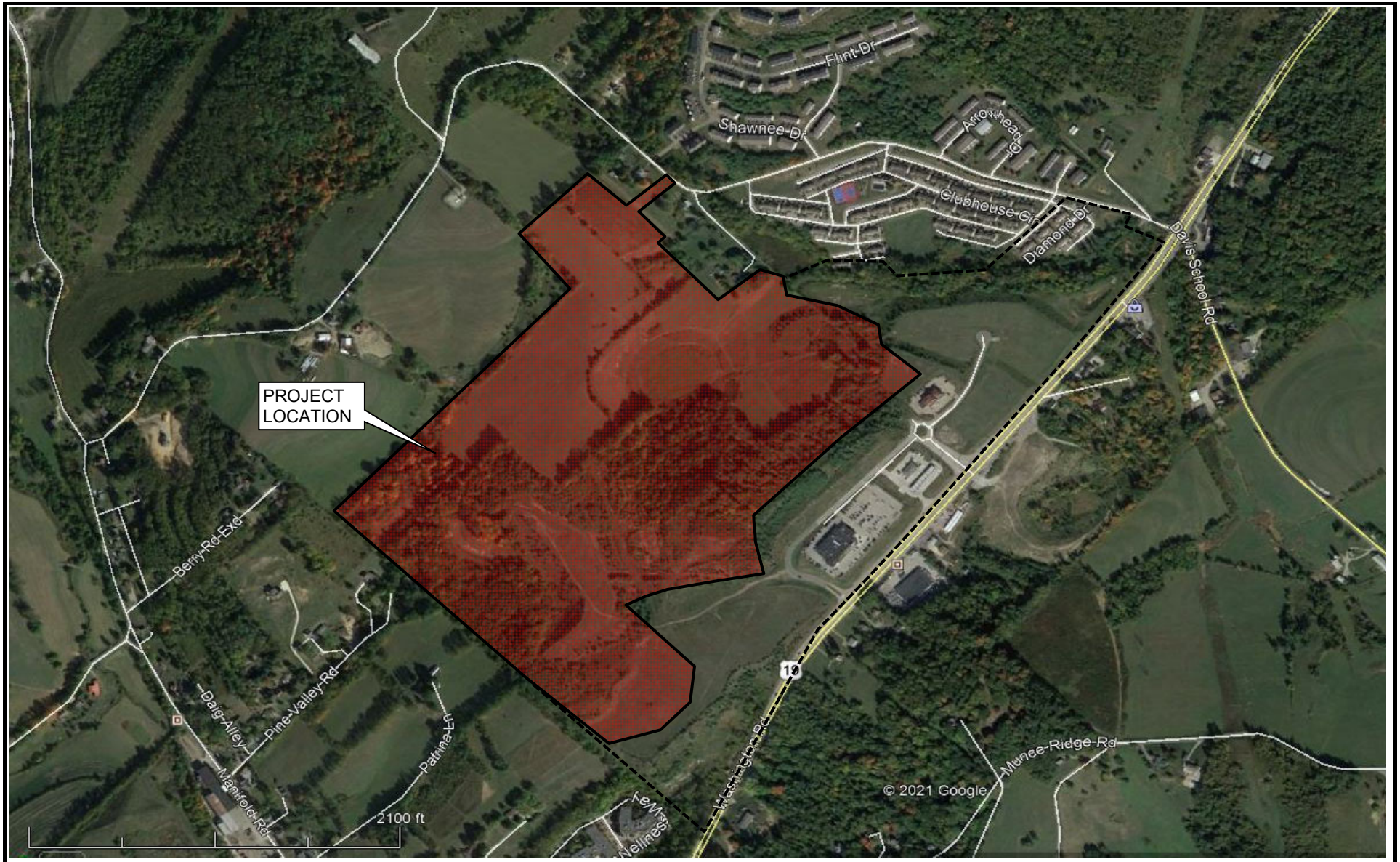
MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TOWNSHIP, WASHINGTON COUNTY, PA

FIGURE 1

GeoMechanics, inc
Consulting Engineers / Scientists

600 Munir Drive, P.O. Box 386
Elizabeth, PA 15037-0386
Phone: (724) 379-6300
Fax: (724) 379-4242
E-Mail: **gmi@geo-mechanics.com**



Date:	May 2021
Scale:	As Shown
Drn. By:	M.E.H.
Chk. By:	J.M.A.
Job No.	21016

AERIAL PHOTOGRAPH OF PROJECT SITE

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TOWNSHIP, WASHINGTON COUNTY, PA

FIGURE 2

GeoMechanics, inc
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Elizabeth, PA 15037-0386
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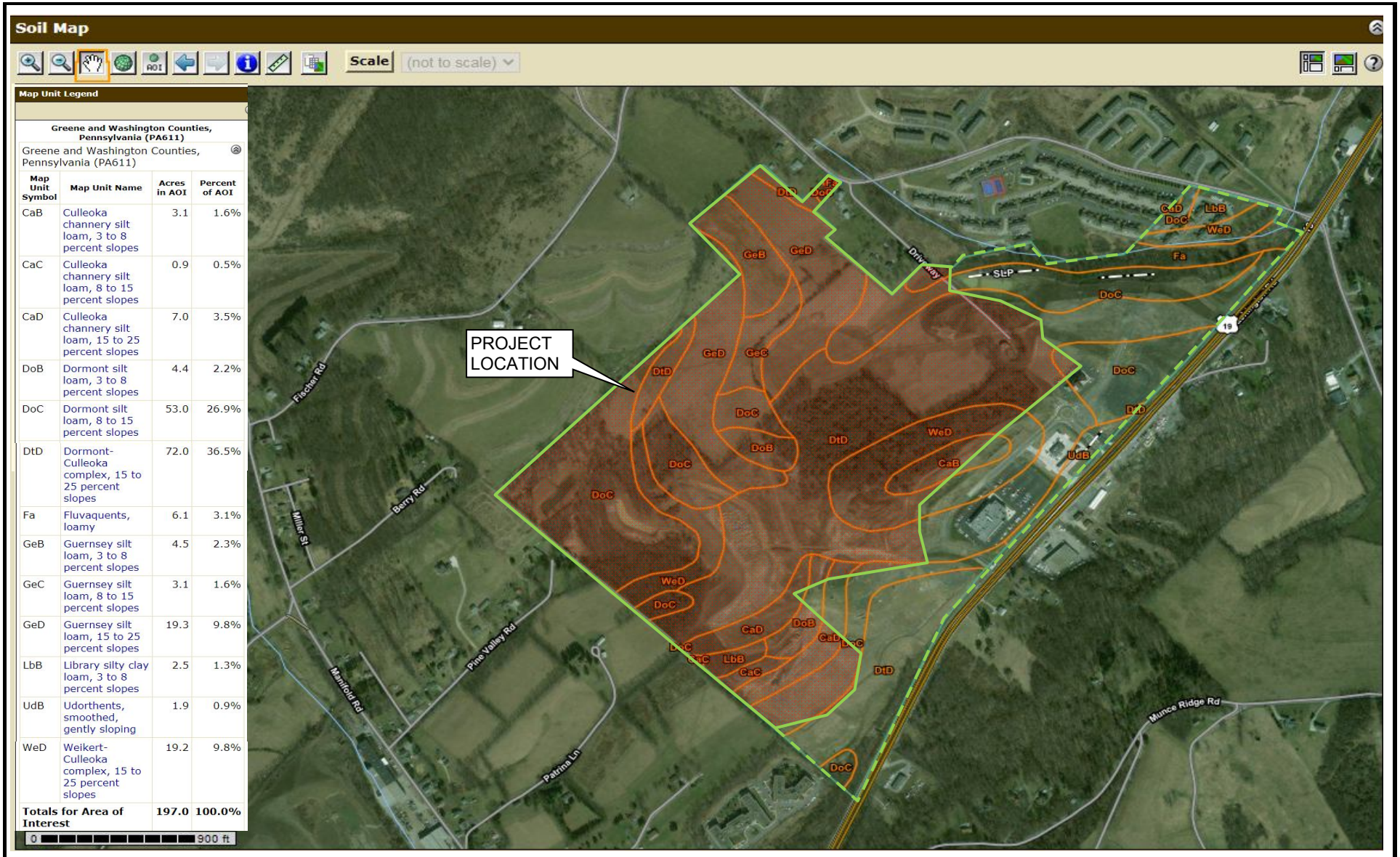

Date:	May 2021
Scale:	As Shown
Drn. By:	M.E.H.
Chk. By:	J.M.A.
Job No.	21016

SOILS MAP

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TOWNSHIP, WASHINGTON COUNTY, PA

FIGURE 3

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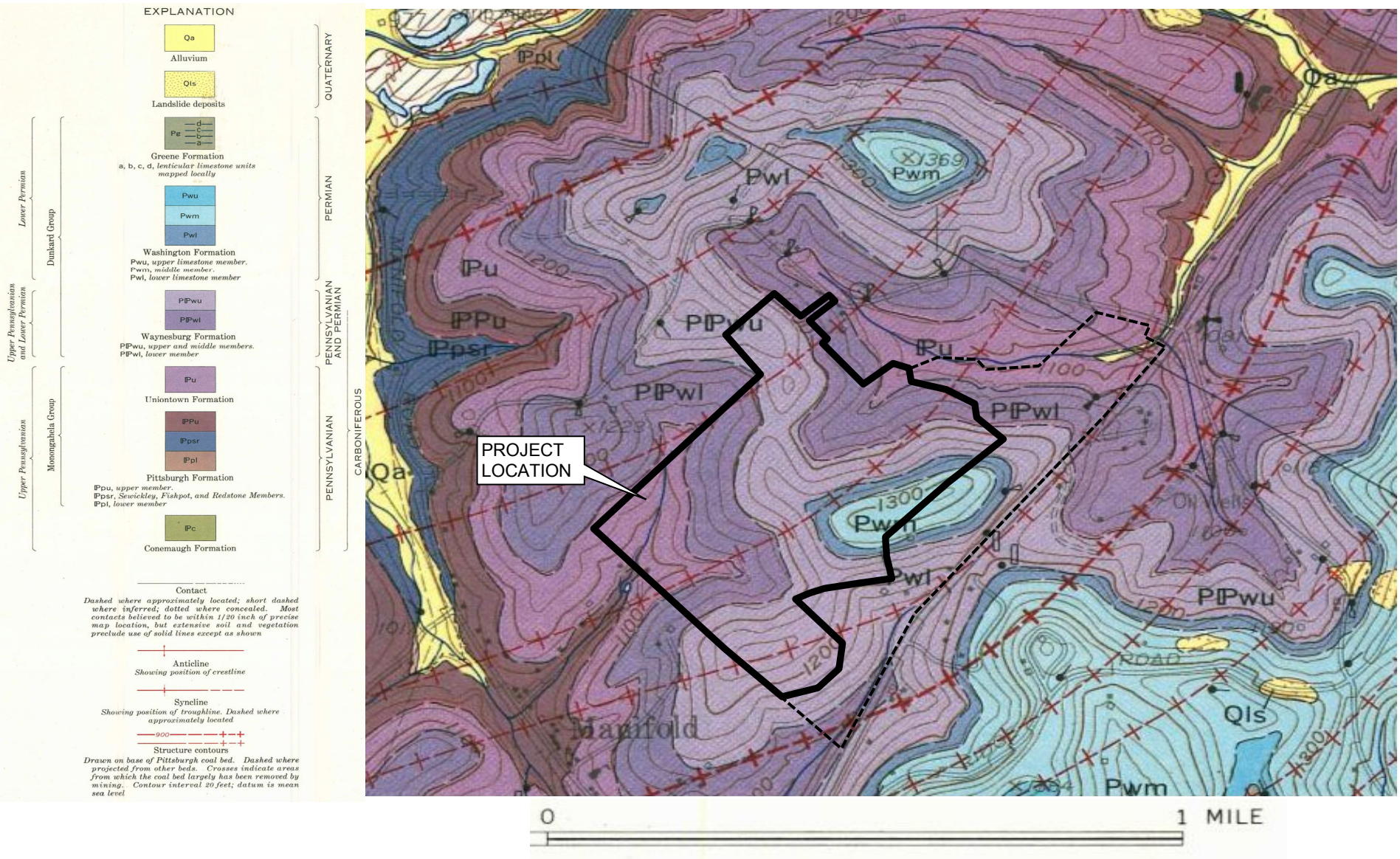

Date:	May 2021
Scale:	As Shown
Drn. By:	M.E.H.
Chk. By:	J.M.A.
Job No.	21016

GEOLOGY MAP

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TOWNSHIP, WASHINGTON COUNTY, PA

FIGURE 4

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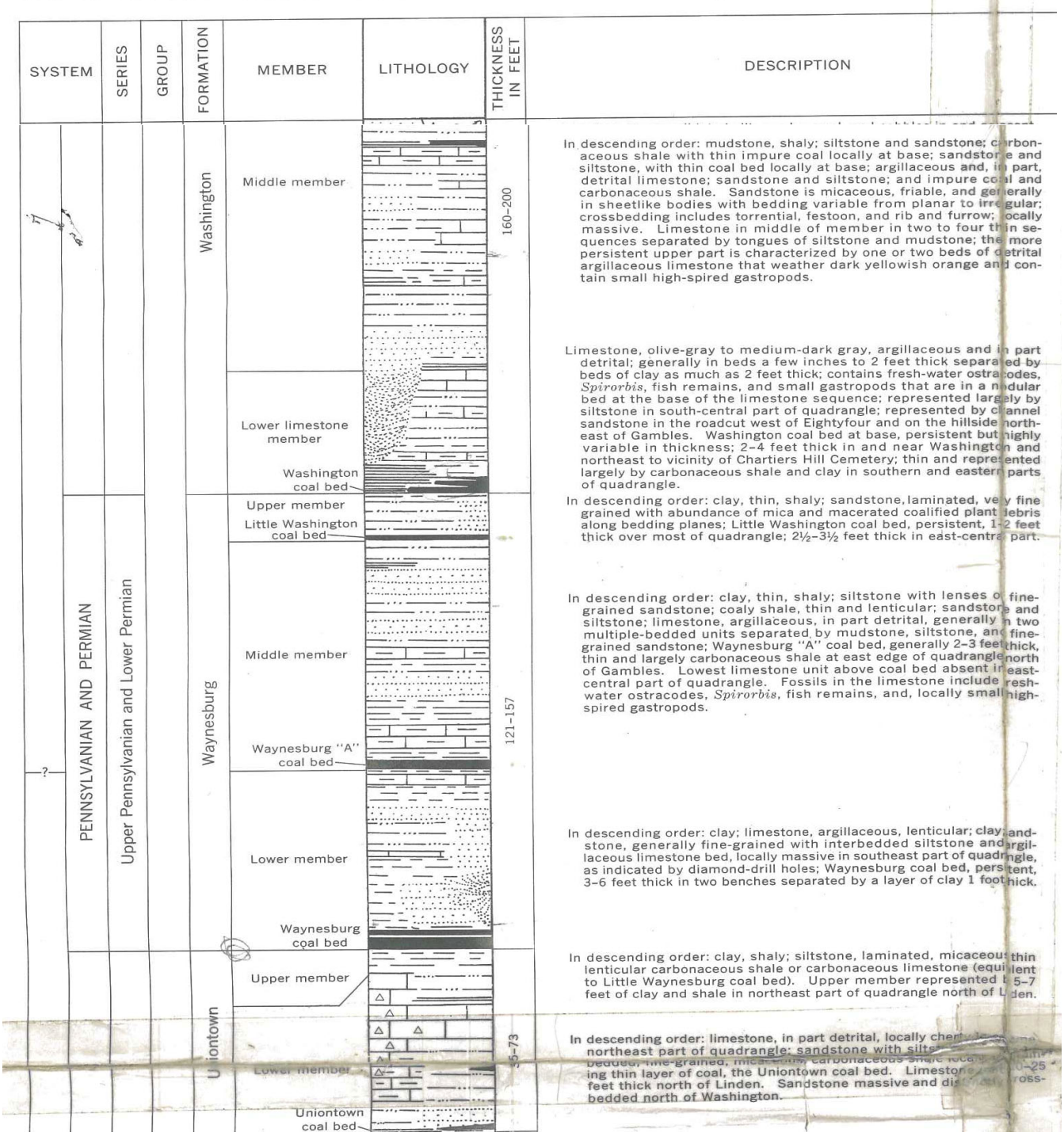
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY



Date:	May 2021
Scale:	None
Drn. By:	M.E.H.
Chk. By:	J.M.A.
Job No.	21016

GEOLOGIC COLUMN
MEADOWS LANDING RESIDENTIAL DEVELOPMENT
SOUTH STRABANE TOWNSHIP, WASHINGTON COUNTY, PA

FIGURE
5

GeoMechanics, inc
Consulting Engineers / Scientists
600 Munir Drive, P.O. Box 386
Elizabeth, PA 15037-0386
Phone: (724) 379-6300
Fax: (724) 379-4242
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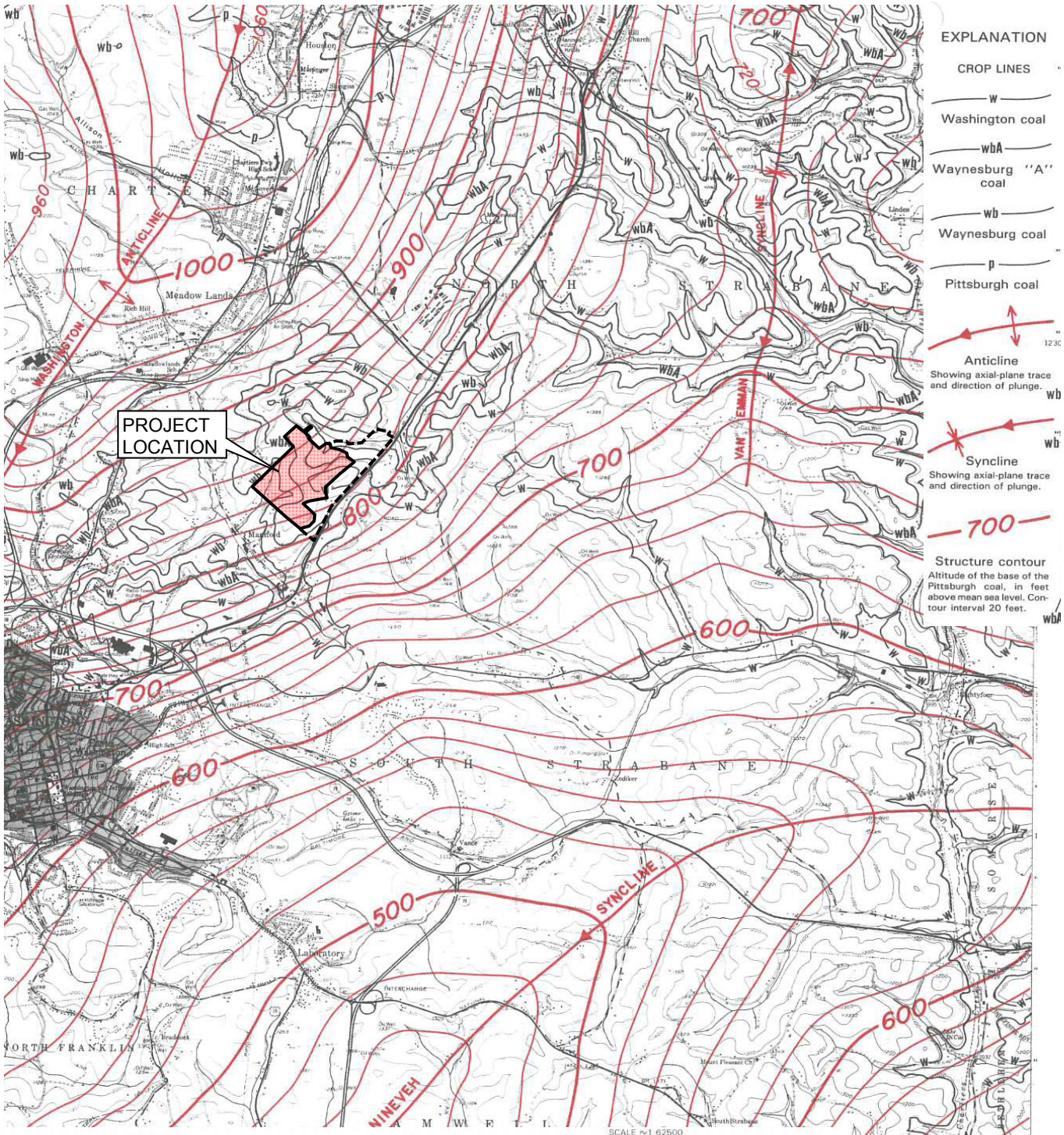

SOURCE

Crop lines modified by V. W. Skema from Kent, B. H. (1967), *Geologic map of the Hackett quadrangle, Washington County, Pennsylvania*, U.S. Geological Survey Geologic Quadrangle Map GQ–630, scale 1:24,000.
Structure contours slightly modified by V. W. Skema from Kent (1967).

COAL CROP LINES AND STRUCTURE CONTOURS

WASHINGTON EAST

Date:	May 2021
Scale:	As Shown
Drn. By:	M.E.H.
Chk. By:	J.M.A.
Job No.	21016

COAL CROP LINES AND STRUCTURE CONTOURS
MEADOWS LANDING RESIDENTIAL DEVELOPMENT

FIGURE
6

GeoMechanics, inc
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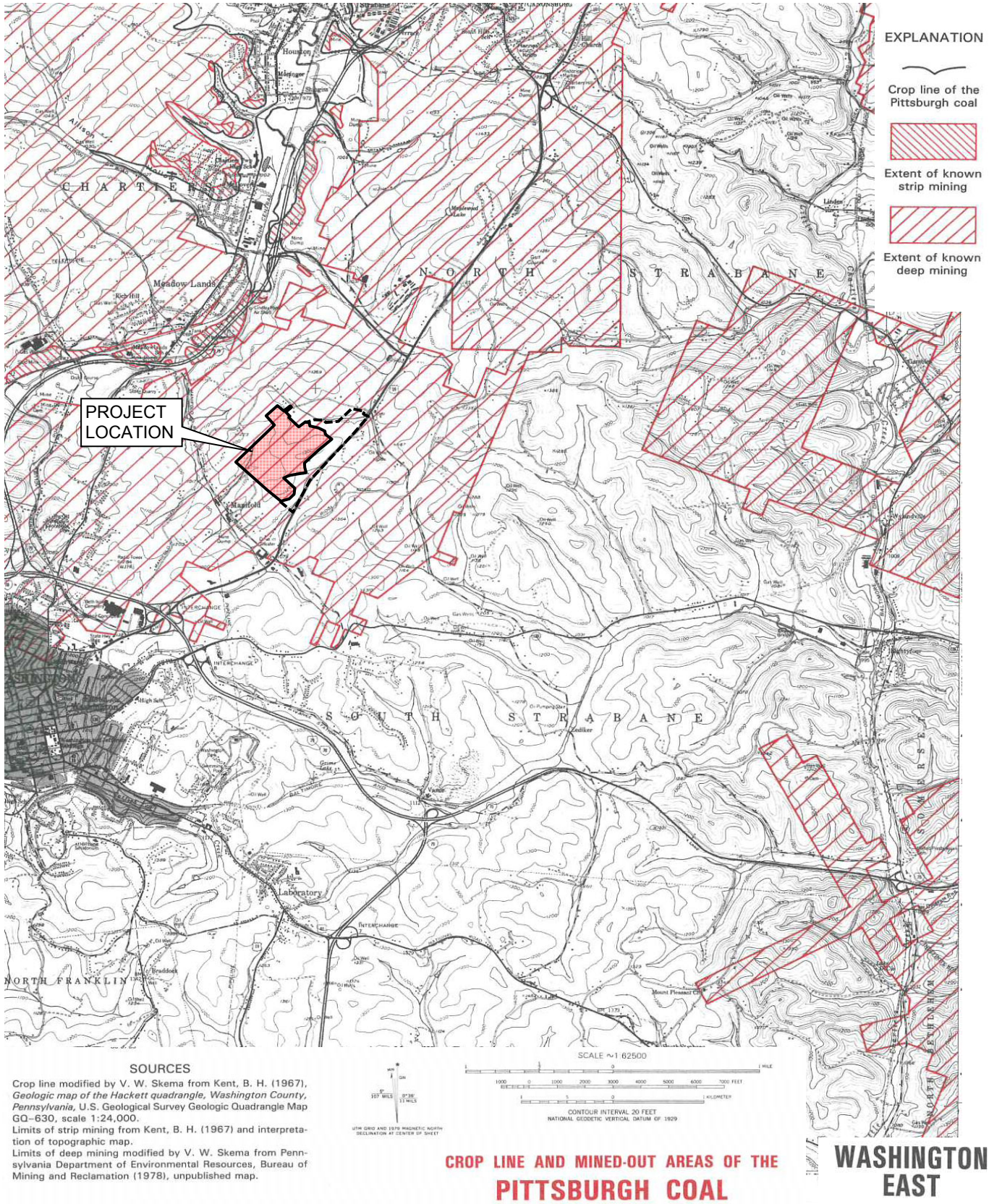

Date:	May 2021
Scale:	As Shown
Drn. By:	M.E.H.
Chk. By:	J.M.A.
Job No.	21016

CROP LINE AND MINED-OUT AREAS OF THE PITTSBURGH COAL
MEADOWS LANDING RESIDENTIAL DEVELOPMENT
SOUTH STRABANE TOWNSHIP, WASHINGTON COUNTY, PA

FIGURE
7

GeoMechanics, inc
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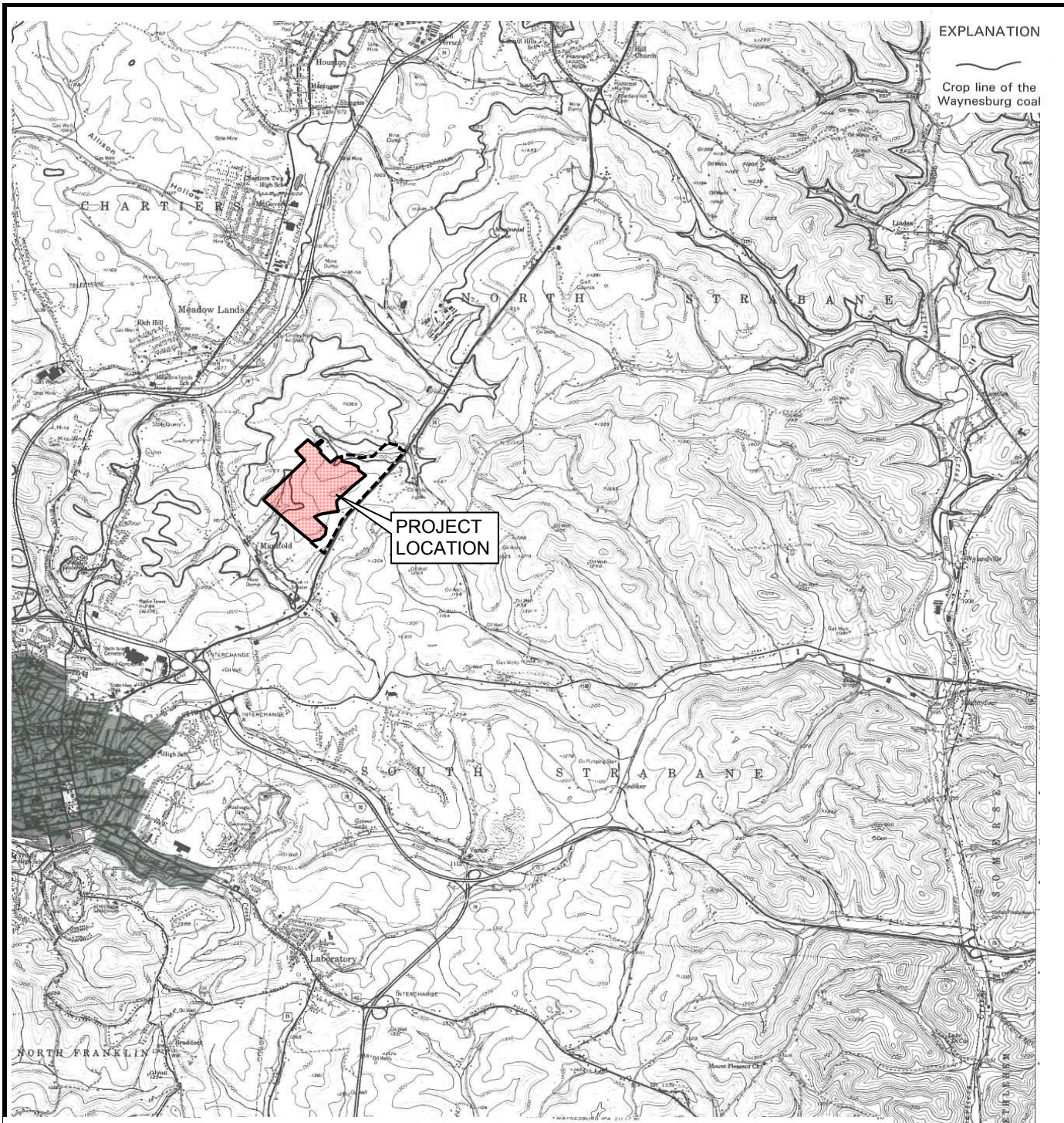

Date:	May 2021
Scale:	As Shown
Drn. By:	M.E.H.
Chk. By:	J.M.A.
Job No.	21016

CROP LINE AND MINED-OUT AREAS OF THE WAYNESBURG COAL
MEADOWS LANDING RESIDENTIAL DEVELOPMENT
SOUTH STRABANE TOWNSHIP, WASHINGTON COUNTY, PA

FIGURE
8

GeoMechanics, inc
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APPENDIX A
Test Boring Records
Current Investigation (TB-1 through TB-17)

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Carlos Trevino | Boring No. TB-1 | Surface Elevation 1234.40 | Sheet No. 1 of 2 sheets

Drill Rig CME-55 | For KGA Partners, LLC.

Water Level: O-Hr. 22.7 24 Hrs. 27.3 | Meadows Landing

Casing Hammer: Wt. _____ lbs. Drop _____ in.

Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA

Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/14/21 Completed 04/15/21 Project No. 21016

Core Bit Size NQ2 | Driller's Log ☐ | Drilling Fluid Water

Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1234.4				2		0.0	Gray SILTY CLAY, Some Sand, Contains Root Fragments And	
				2				
1233				2	1.5	1.4	Other Organics, Soft, Damp	
							(Topsoil)	
							Black CLAYEY SAND, Little Gravel Little Silt, Medium Dense, Damp	
				6				
				10			.Coal and Carbonaceous Shale	
				16	4.5			
							(Residual)	
1228.4						6.0		
				7			Gray to Orange Brown CLAYEY SAND And GRAVEL, Little Silt, Dense to Very Dense, Damp	
				11				
				20	7.5			
							(Residual)	
				9				
				32				
1224.2				50/.2	10.2	10.2		
							Brown to Gray CLAYEY SAND And GRAVEL, Some Silt, Very Dense, Damp to Dry	.Contains Calamities Tree and Other Plant Fossils
				27				
				50/.3	12.8		.Decomposed Shale	
							(Residual)	
				16				
				50/.3	15.8			
				20				
1215.7				50/.3	18.7	18.7		
							Orange Brown to Brown CLAYEY GRAVEL And SAND, Little Silt, Very Dense, Damp	
							.Highly Weathered Sandstone	
				25	21.5			
				50/.0			(Residual)	
				23				
				50/.3	24.8			

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Carlos Trevino | Boring No. TB-1 | Surface Elevation 1234.40 | Sheet No. 2 of 2 sheets

Drill Rig CME-55 | For KGA Partners, LLC.

Water Level: O-Hr. 22.7 | 24 Hrs. 27.3 | Meadows Landing

Casing Hammer: Wt. _____ lbs. Drop _____ in.

Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA

Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/14/21 | Completed 04/15/21 | Project No. 21016

Core Bit Size NQ2 | Driller's Log ☐ | Drilling Fluid Water

Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1207.4							27.0		
					26	27.7		Gray CLAYEY GRAVEL And SAND, Some Silt, Very Dense, Damp to Dry	
					50/.2			.Decomposed Shale	
								(Residual)	
1203.4					31	30.8	31.0		
					50/.3				
		0	0.5	0.0		31.5		Dark Gray SILTSTONE, Thinly to Indistinctly Bedded, Broken, Very Soft to Soft, Residual Soils to Moderately Weathered	Auger Refusal/ Top of Rock @ 31.0'
								.From 32.9-33.4' Moderately Weathered	
								.From 33.4-35.3' Completely Weathered	
1198.2							36.2		
		0	5.0	3.8		36.5		.From 35.3-36.5' Vertical Fracture, Moderately Weathered	
								(RQD=0%)	
								Gray LIMESTONE, Thinly to Thickly Bedded, Blocky to Massive, Hard, Slightly Weathered to Completely Weathered	
1192.9		40	5.0	4.8		41.5	41.5	.Completely Weathered (Loss of Recovery) From 38.0-38.3' and 41.2-41.5'	
								.Vertical Fracture Cemented with Calcite Vein From 36.5-37.5'	
								(RQD=38%)	
								Bottom of Boring @ 41.5'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Carlos Trevino | Boring No. TB-2 | Surface Elevation 1233.0 | Sheet No. 1 of 1 sheets

Drill Rig CME-55 | For KGA Partners, LLC.

Water Level: O-Hr. Dry | 24 Hrs. Dry | Meadows Landing

Casing Hammer: Wt. _____ lbs. Drop _____ in.

Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA

Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/13/21 | Completed 04/13/21 | Project No. 21016

Core Bit Size N/A | Driller's Log ☐ | Drilling Fluid N/A

Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1233				2		0.0	TOPSOIL	
				2				
1231.6				4	1.5	1.4		
							Gray SILTY CLAY, Some Sand, Trace Gravel, Medium, Damp	.Contains Organics and Root Structures
1230						3.0	.Sparse Coal Fragments (Colluvial)	
				8				
				17			Black SILTY SAND, Little Gravel, Dense to Very Dense, Damp to Dry	
				27	4.5			
							.Carbonaceous Shale and Coal (Residual)	
				11				
				33				
1225.5				50	7.5	7.5		
							Brown to Gray SILTY CLAY, Some Gravel, Some Sand, Hard, Damp	.Contains Calamities Tree and Other Plant Fossils
				18				
				50/.3	9.8		.Decomposed Shale (Residual)	
								CL
				16				
				50/.2	12.7			
				16				
1217.1				50/.4	15.9	15.9		
							Brown to Orange Brown CLAYEY SAND, Some Gravel, Very Dense, Damp	
							,Carbonaceous Shale and Coal (Residual)	Auger Refusal/ Top of Rock @ 19.0'
				12	18.7			
1214				50/.2		19.0	Bottom of Boring @ 19.0'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Carlos Trevino | Boring No. TB-3 | Surface Elevation 1107.60 | Sheet No. 1 of 1 sheets

Drill Rig CME-55 | For KGA Partners, LLC.

Water Level: O-Hr. Dry | 24 Hrs. Dry | Meadows Landing

Casing Hammer: Wt. _____ lbs. Drop _____ in.

Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA

Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/20/21 | Completed 04/20/21 | Project No. 21016

Core Bit Size N/A | Driller's Log ☐ | Drilling Fluid N/A

Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1107.6				2		0.0	Brown SILTY CLAY, Trace Sand, Trace Gravel, Medium, Damp	
				2				
1106.1				2	1.5	1.5	.Contains Root Fragments (Topsoil)	
							Brown to Orange Brown SILTY CLAY, Some Sand, Trace Gravel, Medium to Very Stiff, Moist	
				4				
				3				
				3	4.5		(Residual)	
				7				
				8				
				8	7.5			CL
				7				
				7				
				8	10.5			
				9				
1094.6				12		13.0		
				13	13.5		Gray SANDY GRAVEL, Some Silt, Little Clay, Very Dense, Damp to Dry	
				27	15.6		.Highly Weathered Sandstone	
				50/.1			(Residual)	Auger Refusal/ Top of Rock @ 17.0'
1090.6						17.0		
							Bottom of Boring @ 17.0'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Carlos Trevino | Boring No. TB-4 | Surface Elevation 1256.05 | Sheet No. 1 of 2 sheets

Drill Rig CME-55 | For KGA Partners, LLC.

Water Level: O-Hr. 6.8 | 24 Hrs. 7.2 | Meadows Landing

Casing Hammer: Wt. _____ lbs. Drop _____ in.

Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA

Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/09/21 | Completed 04/12/21 | Project No. 21016

Core Bit Size NQ2 | Driller's Log ☐ | Drilling Fluid Water

Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1256.05					3 2 3	1.5	0.0	Brown SANDY CLAY, Some Silt, Trace Gravel, Soft, Damp .Contains Organics (Fill)	
1253.05							3.0		
					5 5 8	4.5		Gray to Brown SILTY CLAY, Some Sand, Trace Gravel, Stiff, Damp (Residual)	
1250.05							6.0		
					4 6 7	7.5		Dark Gray to Brown CLAYEY SILT, Some Sand, Little Gravel, Stiff, Damp (Residual)	
1247.05							9.0		
					9 22 27	10.5		Black SILTY SAND, Trace Gravel, Trace Clay, Medium Dense to Dense, Damp .Coal (Residual)	
					7 12 17	13.5			
1241.05							15.0		
					8 16 14	16.5		Dark Gray to Gray CLAYEY GRAVEL, Some Silt, Some Sand, Medium Dense to Very Dense, Damp to Dry .Decomposed Shale (Residual)	
					25 50/.1	18.6			
1234.55					50/.4	21.4	21.5		
		0	1.0	1.0		22.5		Dark Gray to Gray SHALE With Sandy Laminations, Thinly Laminated to Very Thinly Bedded, Broken to Blocky, Slightly to Highly Weathered	Auger Refusal/ Top of Rock @ 21.5

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Carlos Trevino | Boring No. TB-4 | Surface Elevation 1256.05 | Sheet No. 2 of 2 sheets
Drill Rig CME-55 | For KGA Partners, LLC.
Water Level: O-Hr. 6.8 | 24 Hrs. 7.2 | Meadows Landing
Casing Hammer: Wt. _____ | lbs. Drop _____ | in.
Sampler Hammer: Wt. 140 | lbs. Drop 30 | in. | Location South Strabane Twp., Washington Co., PA
Sampler Size 2 | in. O.D. Casing Size 3¼" | in. I.D. | Started 04/09/21 | Completed 04/12/21 | Project No. 21016
Core Bit Size NQ2 | Driller's Log ☐ | Drilling Fluid Water
Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
								.Clayey From 22.5-25.5' and 27.5-29.5'	
		0	5.0	5.0		27.5		(RQD=0%)	
1226.55							29.5		
								Gray SILTSTONE With Sandstone Bands, Very Thinly to Thinly Bedded, Broken to Blocky, Medium Hard, Slightly Weathered	
1223.55		0	5.0	5.0		32.5	32.5	(RQD=0%)	
								Bottom of Boring @ 32.5'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Carlos Trevino | Boring No. TB-5 | Surface Elevation 1211.60 | Sheet No. 1 of 2 sheets

Drill Rig CME-55 | For KGA Partners, LLC.

Water Level: O-Hr. Dry | 24 Hrs. 31.4 | Meadows Landing

Casing Hammer: Wt. _____ lbs. Drop _____ in.

Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA

Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/20/21 | Completed 04/20/21 | Project No. 21016

Core Bit Size N/A | Driller's Log ☐ | Drilling Fluid N/A

Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1211.6				6 6 10	1.5	0.0	Orange Brown SANDY CLAY, Little Gravel, Very Stiff, Damp (Colluvial)	
1208.6						3.0		
				4 8 15	4.5		Gray to Brown SILTY CLAY, Little Sand, Trace Gravel, Very Stiff to Hard, Damp (Residual)	CL
				10 10 12	7.5			
				14 50/.3	9.8			
1199.6						12.0		
				16 41 50/.3	13.3		Black SILTY SAND, Some Clay, Little Gravel, Loose to Very Dense, Damp .Possible Mine Gob .Coal Refuse/Carbonaceous Shale (Residual)	
				7 2 2	16.5			
1193.6						18.0		
				39 50/.4	18.9		Gray CLAYEY SAND, Some Gravel, Very Dense, Dry .Weathered Limestone (Residual)	
				50 50/.2	21.7			
1187.6						24.0		
				18 50				

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Carlos Trevino
Drill Rig CME-55
Water Level: O-Hr. Dry 24 Hrs. 31.4
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size N/A
Orientation Vertical

Boring No. TB-5 Surface Elevation 1211.60 Sheet No. 2 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., Washington Co., PA
Started 04/20/21 Completed 04/20/21 Project No. 21016
Driller's Log ☐
Geologist's Log ☒ SAF
Drilling Fluid N/A

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
				50/.1	25.1		Gray CLAYEY SAND, Some Silt, Some Gravel, Very Dense, Damp to Dry	
				27			.Decomposed Argillaceous Shale	
				50	28.1		(Residual)	
				50/.1				
1180.9				50	30.7	30.7		Top of Rock @ 30.7'
				50/.2			Bottom of Boring @ 30.7'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Carlos Trevino | Boring No. TB-6 | Surface Elevation 1203.00 | Sheet No. 1 of 1 sheets

Drill Rig CME-55 | For KGA Partners, LLC.

Water Level: O-Hr. Dry | 24 Hrs. Dry | Meadows Landing

Casing Hammer: Wt. _____ | lbs. Drop _____ | in.

Sampler Hammer: Wt. 140 | lbs. Drop 30 | in. | Location South Strabane Twp., Washington Co., PA

Sampler Size 2 | in. O.D. Casing Size 3¼" | in. I.D. | Started 04/08/21 | Completed 04/08/21 | Project No. 21016

Core Bit Size N/A | Driller's Log ☐ | Drilling Fluid N/A

Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1203				3		0.0	Dark Gray to Brown SILTY CLAY, Some Sand, Trace Gravel, Medium Stiff, Damp	
				3				
				4	1.5		.Contains Coal Fragments and Organics	
1200						3.0	(Fill)	
				4			Orange Brown to Gray SILTY CLAY, Little Sand, Little Gravel, Stiff to Very Stiff, Moist	
				7				
				10	4.5		(Residual)	CL
				4				
				8				
				8	7.5			
1193.5				3	9.5	9.5		
				50/.2			Gray to Brown CLAYEY GRAVEL, Little Sand, Very Dense, Damp	
							.Decomposed Limestone	
1190.4				25	12.6	12.6	(Residual)	Top of Rock @ 12.6'
				50/.1			Bottom of Boring @ 12.6'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Carlos Trevino | Boring No. TB-7 | Surface Elevation 1112.30 | Sheet No. 1 of 1 sheets

Drill Rig CME-55 | For KGA Partners, LLC.

Water Level: O-Hr. Dry 24 Hrs. Dry | Meadows Landing

Casing Hammer: Wt. _____ lbs. Drop _____ in.

Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA

Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/20/21 Completed 04/20/21 Project No. 21016

Core Bit Size N/A | Driller's Log ☐ | Drilling Fluid N/A

Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1112.3				6 7 12	1.5	0.0	Brown SANDY CLAY, Some Silt, Little Gravel, Very Stiff, Damp (Residual)	
1108.8				7 7 10	4.5	3.5	Brown SILTY SAND And GRAVEL, Little Clay, Medium Dense to Very Dense, Damp	
				50/.4	6.4		.Highly Weathered Sandstone (Residual)	
1102.3				17 50/.2	9.7	10.0		Auger Refusal/ Top of Rock @ 10.0'
							Bottom of Boring @ 10.0'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart | Boring No. TB-8 | Surface Elevation 1116.74 | Sheet No. 1 of 1 sheets

Drill Rig CME-55 | For KGA Partners, LLC.

Water Level: O-Hr. Dry | 24 Hrs. Dry | Meadows Landing

Casing Hammer: Wt. _____ lbs. Drop _____ in.

Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA

Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/20/21 | Completed 04/20/21 | Project No. 21016

Core Bit Size N/A | Driller's Log ☐ | Drilling Fluid N/A

Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1116.74				1		0.0	Orange Brown SILTY CLAY, Some Sand, Medium, Damp	
				2				
1115.24				3	1.5	1.5	.Contains Root Fragments and Structures	
							(Residual)	
				5			Brown SILTY CLAY, Little Sand, Trace Gravel, Stiff, Moist	CL
				6				
				8	4.5		.Decomposed Shale	
							(Residual)	
				5				
				8				
				8	7.5			
1107.74						9.0		
				6			Brown to Gray CLAYEY GRAVEL And SAND, Little Silt, Medium Dense to Very Dense, Damp to Dry	
				11				
				2	10.5		.Weathered Sandstone	
							(Residual)	
				50/.4	12.4			
1101.64						15.1		
				50/.1	15.1		Bottom of Boring @ 15.1'	Top of Rock @ 15.1'

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Carlos Trevino | Boring No. TB-9 | Surface Elevation 1185.06 | Sheet No. 1 of 1 sheets

Drill Rig CME-55 | For KGA Partners, LLC.

Water Level: O-Hr. Dry | 24 Hrs. 10.2 | Meadows Landing

Casing Hammer: Wt. _____ lbs. Drop _____ in.

Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA

Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/07/21 | Completed 04/07/21 | Project No. 21016

Core Bit Size N/A | Driller's Log ☐ | Drilling Fluid N/A

Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1185.06				4		0.0	TOPSOIL	
1184.76				4		0.3	Brown Mottled Gray SILTY CLAY,	
				5	1.5		Some Sand, Little Gravel, Stiff, Damp	
1182.06						3.0	(Colluvial)	
				3			Brown to Orange-Brown SILTY	
				6			CLAY, Some Sand, Trace Gravel,	
				11	4.5		Very Stiff, Damp	CL
							(Colluvial)	
				7				
				11				
				13	7.5			
1176.06						9.0		
				4			Gray CLAYEY SAND, Some Gravel,	
				9			Some Silt, Medium Dense, Damp	
				7	10.5		.Decomposed Siltstone	
1173.06						12.0	(Residual)	
				7			Brown to Gray SILTY To CLAYEY	
				18			GRAVEL And SAND, Dense to Very	
				22	13.5		Dense, Damp	
							.Decomposed Siltstone	
							(Residual)	
				10				
				24				
				25	16.5			
				5				
				25				Top of Rock @ 19.4'
1165.66				50/.4	19.4	19.4		
							Bottom of Boring @ 19.4'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Carlos Trevino | Boring No. TB-10 | Surface Elevation 1144.40 | Sheet No. 1 of 1 sheets

Drill Rig CME-55 | For KGA Partners, LLC.

Water Level: O-Hr. 8.2 | 24 Hrs. 7.6 | Meadows Landing

Casing Hammer: Wt. _____ lbs. Drop _____ in.

Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA

Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/07/21 | Completed 04/07/21 | Project No. 21016

Core Bit Size N/A | Driller's Log ☐ | Drilling Fluid N/A

Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1144.4				3		0.0	TOPSOIL	
1143.9				2		0.5	Brown Mottled Gray to Black SILTY CLAY, Some Sand, Trace Gravel, Medium to Very Stiff, Moist	CL
				3	1.5			
							.Organics in Sample	
				4				
				6			(Colluvial)	
				11	4.5			
				4				
				7				
1136.9				7	7.5	7.5		
							Gray CLAYEY GRAVEL And SAND, Some Silt, Medium Dense, Damp	
				4			.Decomposed Siltstone	
				6				
				8	10.5		(Residual)	
1132.4						12.0		
				7			Black CLAYEY GRAVEL, Some Sand, Little Silt, Very Dense, Damp	Auger Refusal/ Top of Rock @ 13.5'
				7	13.1			
1130.9				50/.1		13.5	.Decomposed Carbonaceous Shale (Residual)	
							Bottom of Boring @ 13.5'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig CME-55
Water Level: O-Hr. 32.8 24 Hrs. Caved
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size N/A Driller's Log ☐
Orientation Vertical Geologist's Log ☒ SAF

Boring No. TB-11 Surface Elevation 1306.1 Sheet No. 1 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., Washington Co., PA
Started 04/14/21 Completed 04/14/21 Project No. 21016
Drilling Fluid N/A

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1306.1					2		0.0	TOPSOIL	
1305.5					3		0.6	Brown CLAYEY SAND And SILT, Little Gravel, Loose to Medium Dense, Damp	
					3	1.5			
								(Residual)	
					15				
1302.1					8		4.0		
					9	4.5		Brown to Orange Brown CLAYEY SAND And GRAVEL, Very Dense, Damp to Dry	
								.Decomposed Sandstone	
					9				
					23			(Residual)	
					50/.4	7.4			
1296.5					50/.4	9.4	9.6		
		0	1.9	1.9		11.5		Gray to Brown SANDSTONE, Thinly to Thickly Bedded, Blocky to Massive, Hard, Slightly Weathered to Highly Weathered	Auger Refusal/ Top of Rock @ 9.6'
								.From 15.0-16.5' Vertical Joint with Crystalline Calcite on Joint Faces (Probable Cause to Lost Water)	.Lost Return Water @ 15.5'
								.Conjugate Joint @ 20.0 Feet, RD=40°	
		40	5.0	5.0		16.5		(RQD=21%)	
		8	5.0	5.0		21.5			
1283.3							22.8		
								Gray to Dark Gray SHALE, Laminated Bedding, Broken, Very Soft, Completely Weathered to Residual Soils	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig CME-55
Water Level: O-Hr. 32.8 24 Hrs. Caved
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size N/A
Orientation Vertical

Boring No. TB-11 Surface Elevation 1306.1 Sheet No. 2 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., Washington Co., PA
Started 04/14/21 Completed 04/14/21 Project No. 21016
Driller's Log ☐
Geologist's Log ☒ SAF
Drilling Fluid N/A

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
								.Contains Sulfur and Iron Staining Throughout	
1279.6		8	5.0	5.0		26.5	26.5	(RQD=0%)	
								Black COAL, Indistinct Bedding, Indistinct Discontinuities, Very Soft, Completely Weathered	
								.Appears to Be Mine Gob/Refuse, Low Recovery, Likely Blew Away	
1275.6							30.5	(RQD=0%)	
		0	5.0	1.6		31.5		Gray to Dark Gray LIMESTONE, Medium Bedded, Blocky Hard to Very Soft, Fresh to Completely Weathered	
								.Dark Gray, Very Soft and Completely Weathered From 32.8-33. 8', 34.1-34.3', 36.0-37.5', 39.2- 40.2' and 40.5-41.5'	
		24	5.0	1.2		36.5		(RQD=19%)	
1264.6		18	5.0	0.9		41.5	41.5		
								Bottom of Boring @ 41.5'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Carlos Trevino | Boring No. TB-12 | Surface Elevation 1170.35 | Sheet No. 1 of 1 sheets
Drill Rig CME-55 | For KGA Partners, LLC.
Water Level: O-Hr. Dry | 24 Hrs. 13.0 | Meadows Landing
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/06/21 | Completed 04/06/21 | Project No. 21016
Core Bit Size N/A | Driller's Log ☐ | Drilling Fluid N/A
Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1170.35				3		0.0	Brown SILTY CLAY, Trace Sand, Trace Gravel, Stiff, Moist	
				7				
1168.85				5	1.5	1.5	.Contains Organics (Topsoil)	
							Light Brown to Gray SILTY SAND And GRAVEL, Some Clay, Medium Dense, Dry	
				6				
				10				
				13	4.5		.Decomposed Siltstone (Residual)	
				15				
				11				
				12	7.5			
1161.35						9.0		
				6			Gray CLAYEY GRAVEL And SAND, Little Silt, Very Dense, Damp to Dry	
				23				
				33	10.5		.Decomposed Shale (Residual)	
				50/.3	12.3			
1154.75				21	15.6	15.6		Top of Rock @ 15.6'
				50/.1			Bottom of Boring @ 15.6'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller: Carlos Trevino
Drill Rig: CME-55
Water Level: O-Hr. Dry 24 Hrs. 7.3
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size N/A Driller's Log ☐
Orientation Vertical Geologist's Log ☒ SAF

Boring No. TB-13 Surface Elevation 1230.20 Sheet No. 1 of 1 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., Washington Co., PA
Started 04/06/21 Completed 04/06/21 Project No. 21016
Drilling Fluid N/A

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1230.2				2		0.0	Brown SILTY CLAY And SAND, Medium, Moist	
				3			.Trace Coal Fragments	
				3	1.5		(Residual)	
1227.2						3.0		
				3			Black CLAYEY SAND, Little Gravel, Trace Clay, Medium Dense, Damp	
				4				
				8	4.5		.Coal	
1224.2						6.0	(Residual)	
				6			Brown CLAYEY GRAVEL And SAND, Medium Dense, Damp	
				8				
				11	7.5		(Residual)	
1221.2						9.0		
				4			Brown to Gray SANDY CLAY, Some Silt, Little Gravel, Stiff to Very Stiff, Moist to Damp	
				4				
				4	10.5		.Decomposed Siltstone with Calcareous Nodules	
							(Residual)	
				4				
				9				
				10	13.5			
1215.2						15.0		
				9			Gray to Brown CLAYEY GRAVEL, Little Silt, Very Dense, Wet to Moist	.Hit Water @ 15.0'
				14				
				40	16.5		.Decomposed Limestone	Auger Refusal/ Top of Rock @ 17.0'
1213.2						17.0	(Residual)	
							Bottom of Boring @ 17.0'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart | Boring No. TB-14 | Surface Elevation 1213.85 | Sheet No. 1 of 2 sheets

Drill Rig CME-55 | For KGA Partners, LLC.

Water Level: O-Hr. Dry | 24 Hrs. Dry | Meadows Landing

Casing Hammer: Wt. _____ lbs. Drop _____ in.

Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA

Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/16/21 | Completed 04/16/21 | Project No. 21016

Core Bit Size N/A | Driller's Log ☐ | Drilling Fluid N/A

Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1213.85				1		0.0	TOPSOIL	
1213.55				3		0.3	Brown to Black SILTY CLAY, Some Sand, Little Gravel, Medium to Stiff, Damp	CL
				3	1.5		.Contains Carbonaceous Shale Fragments	
							(Colluvial)	
				5				
				6				
				6	4.5			
				5				
				5				
				7	7.5			
1204.85						9.0		
				5			Gray SILTY CLAY, Trace Gravel, Trace Sand, Stiff, Damp	
				3				
				7	10.5		.Decomposed Claystone	
							(Residual)	
1201.85						12.0		
				15			Black CLAYEY GRAVEL And SAND, Trace Silt, Medium Dense to Very Dense, Damp to Dry	
				27				
				40	13.5		.Decomposed Carbonaceous Shale and Coal	
				27				
				15			(Residual)	
				15	16.5			
1195.85						18.0		
				43	18.7		Gray CLAYEY GRAVEL, Little Sand, Little Silt, Very Dense, Dry	
				50/.2			.Decomposed Limestone	
							(Residual)	
1192.85						21.0		
				22			Gray to Tan SILTY CLAY, Some Gravel, Some Sand, Very Dense, Damp	
				38				
				50/.3	22.3		.Decomposed Claystone	
							(Residual)	Top of Rock @ 25.2'
				32				
				40				

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig CME-55
Water Level: O-Hr. Dry 24 Hrs. Dry
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size N/A
Orientation Vertical

Boring No. TB-14 Surface Elevation 1213.85 Sheet No. 2 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., Washington Co., PA
Started 04/16/21 Completed 04/16/21 Project No. 21016
Driller's Log ☐
Geologist's Log ☒ SAF
Drilling Fluid N/A

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1188.65				50/.2	25.2	25.2	Bottom of Boring @ 25.2'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller: Matt Hart
Drill Rig: CME-55
Water Level: O-Hr. Dry 24 Hrs. 26.1
Casing Hammer: Wt. ____ lbs. Drop ____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size N/A
Orientation Vertical

Boring No. TB-15 Surface Elevation 1190.0 Sheet No. 1 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., Washington Co., PA
Started 04/16/21 Completed 04/16/21 Project No. 21016
Driller's Log ☐
Geologist's Log ☒ SAF
Drilling Fluid N/A

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1190				2		0.0	Brown to Orange Brown SANDY CLAY Little Gravel, Little Silt, Medium Stiff, Damp	
				2				
				3	1.5			
							(Colluvial)	
1187						3.0		
				6			Orange-Brown SILTY CLAY, Some Sand, Trace Gravel, Stiff to Hard, Dru	
				7				
				7	4.5		.Decomposed Siltstone	
							(Residual)	
				7				
				7				
				7	7.5			CL
				9				
				12				
				12	10.5			
				11				
				25				
				43	13.5			
				25				
				21				
				13	16.5			
1172						18.0		
				21			Gray CLAYEY SAND, Some Gravel, Little Silt, Very Dense, Damp to Dry	
				50/.4	18.9			
							.Decomposed Sandy Shale	
				50				
				50/.2	21.7		(Residual)	
				48				
				50/.1	24.6			

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart | Boring No. TB-15 | Surface Elevation 1190.0 | Sheet No. 2 of 2 sheets

Drill Rig CME-55 | For KGA Partners, LLC.

Water Level: O-Hr. Dry | 24 Hrs. 26.1 | Meadows Landing

Casing Hammer: Wt. _____ lbs. Drop _____ in.

Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA

Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/16/21 | Completed 04/16/21 | Project No. 21016

Core Bit Size N/A | Driller's Log ☐ | Drilling Fluid N/A

Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
				50	27.6			
				50/.1				
1159.8						30.2		Top of Rock @ 30.2'
				50/.2	30.2		Bottom of Boring @ 30.2'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Carlos Trevino | Boring No. TB-16 | Surface Elevation 1226.90 | Sheet No. 1 of 1 sheets

Drill Rig CME-55 | For KGA Partners, LLC.

Water Level: O-Hr. Dry | 24 Hrs. Dry | Meadows Landing

Casing Hammer: Wt. _____ lbs. Drop _____ in.

Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA

Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/06/21 | Completed 04/06/21 | Project No. 21016

Core Bit Size N/A | Driller's Log ☐ | Drilling Fluid N/A

Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1226.9				3		0.0	TOPSOIL	
1226.4				3		0.5	Brown SILTY CLAY, Some Sand,	
				4	1.5		Medium, Damp	
							.Contains Organics	
							(Colluvial)	
1223.9						3.0		
				6			Brown SILTY CLAY, Some Sand,	
				5			Stiff, Moist	
				5	4.5			
							.Siltstone with Calcareous	
							Siderite Nodules	
1220.9						6.0	(Residual)	
				4			Brown to Gray CLAYEY GRAVEL,	
				6			Some Sand, Little Silt, Medium	
				10	7.5		Dense, Damp	
							.Decomposed Siltstone	
1217.9						9.0	(Residual)	
				4			Gray CLAYEY GRAVEL, Some Sand,	
				42	10.2		Some Silt, Very Dense, Dry	Top of Rock/
				50/.2			.Decomposed Limestone	Auger Refusal
1215.9						11.0	(Residual)	@ 11.0'
							Bottom of Boring @ 11.0'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart | Boring No. TB-17 | Surface Elevation 1204.75 | Sheet No. 1 of 2 sheets
Drill Rig CME-55 | For KGA Partners, LLC.
Water Level: O-Hr. Dry 24 Hrs. Dry | Meadows Landing
Casing Hammer: Wt. ____ lbs. Drop ____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., Washington Co., PA
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 04/15/21 Completed 04/15/21 Project No. 21016
Core Bit Size N/A | Driller's Log ☐ | Drilling Fluid N/A
Orientation Vertical | Geologist's Log ☒ SAF

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1204.75				2		0.0	Brown to Gray SILTY CLAY, Trace Sand, Trace Gravel, Medium to Stiff, Moist	
				2				
				4	1.5			
							.Contains Root Fragments/ Structures	CL
							(Colluvial)	
				4				
				4				
				5	4.5			
1198.75						6.0		
				5			Light Gray to Orange Brown SANDY CLAY, Some Silt, Little Gravel, Stiff to Very Stiff, Damp	
				6				
				4	7.5			
							(Residual)	
				7				
				8				
				14	10.5			
1192.75						12.0		
				22			Gray CLAYEY SAND, Some Gravel, Some Silt, Very Dense, Damp to Dry	
				39				
				50/.4	13.4			
							.Decomposed Shale with Fissile Fabric Preserved	
				23			(Residual)	
				37				
				30	16.5			
1186.75						18.0		
				50/.2	18.2		Brown to Orange Brown SILTY GRAVEL And SAND, Little Clay, Very Dense, Damp to Dry	
							.Decomposed Sandstone	
				27			(Residual)	
				50/.4	21.9			
				27				Top of Rock @ 25.5'
				35				

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig CME-55
Water Level: O-Hr. Dry 24 Hrs. Dry
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size N/A
Orientation Vertical

Boring No. TB-17 Surface Elevation 1204.75 Sheet No. 2 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., Washington Co., PA
Started 04/15/21 Completed 04/15/21 Project No. 21016
Driller's Log ☐
Geologist's Log ☒ SAF
Drilling Fluid N/A

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1179.25					22	25.5	25.5		
								Bottom of Boring @ 25.5'	

APPENDIX A-1:

Relevant GeoMechanics, Inc. Test Boring Records
2012 Geotechnical Investigation
GB-1 through GB-25
P-1 through P-8

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Joe Durko
Drill Rig CME-55
Water Level: O-Hr. 88.2 24 Hrs.
Casing Hammer: Wt. ____ lbs. Drop ____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ JMA/TDW

Boring No. GB-5 Surface Elevation 1308.0 Sheet No. 1 of 5 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 03/28/12 Completed 03/30/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1308					3		0.0	TOPSOIL	
1307.5					3		0.5	Brown Gray Mottled SILTY CLAY, Little Sand, Trace Gravel (Rock Fragments), Medium Stiff to Hard, Moist to Damp	
					4	1.5			
								(Residual)	CL
					9				
					10				
					11	4.5			
					10				
					14				
					20	7.5			
1300							8.0		
								Brown Gray SILTY CLAY, Some Sand, Little Gravel, Little Silt, Very Dense, Damp	
					20				
					33				
					50/.4	10.4		(Decomposed Rock)	
					50/.1	12.1			
1292.9							15.1		
					50/.1	15.1		Brown And Gray Micaceous Fine-Grained SANDSTONE, Thinly Laminated to Thinly Bedded, Broken to Blocky, Medium Hard	Top of Rock @ 15.1'
		0	1.9	1.9		17.0		.Very Shaly in Upper Portion From 15.1-19.0'	.Lost Water @ 18.0'
								.Moderately Weathered	
								(RQD=19%)	
		18	5.0	4.3		22.0			
1284.6							23.4		
								Brown SILTY SHALE, Thinly Laminated, Broken, Soft	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Joe Durko
Drill Rig CME-55
Water Level: O-Hr. 88.2 24 Hrs.
Casing Hammer: Wt. ____ lbs. Drop ____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ JMA/TDW

Boring No. GB-5 Surface Elevation 1308.0 Sheet No. 2 of 5 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 03/28/12 Completed 03/30/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
								.Moderately Weathered	
		14	5.0	5.0		27.0		.Highly Weathered From 30.5-32.0'	
								(RQD=0%)	
1276		0	5.0	3.6		32.0	32.0		
								Dark Gray CLAY And CARBONACEOUS SHALE, Thinly Laminated, Very Broken, Very Soft	.Boundary Estimated Due to Poor Recovery
								.Highly Weathered	
								(RQD=0%)	
1271.4		0	5.0	1.8		37.0	36.6		
								Gray LIMESTONE WIth Occasional Soil Seams, Thinly Bedded, Broken to Blocky, Hard	
								.Vertical Fracture With Stains From 39.1-39.9'	
								.Poor Recovery Due to Soft Clay/ Claystone Beds	
		0	5.0	3.2		42.0		(RQD=0%)	
1265.6							42.4		
								Gray CALCAREOUS CLAYSTONE, Indiscernible Bedding, Broken, Very Soft	
								(RQD=0%)	
1261.4		0	5.0	5.0		47.0	46.6		
								Gray LIMESTONE With CLAYSTONE BEDS, Very Thinly to Thinly Bedded, Very Broken to Blocky, Hard (Limestone) to Very Soft (Claystone)	
								(RQD=6%)	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Joe Durko
Drill Rig CME-55
Water Level: O-Hr. 88.2 24 Hrs.
Casing Hammer: Wt. lbs. Drop in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ JMA/TDW

Boring No. GB-5 Surface Elevation 1308.0 Sheet No. 3 of 5 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 03/28/12 Completed 03/30/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
		8	5.0	3.6		52.0			
1255							53.0		
								Dark Gray CLAYSTONE, Indiscernible Bedding, Broken to Blocky, Soft to Very Soft (RQD=0%)	Boundary Estimated Due to Poor Recovery
		0	5.0	1.0		57.0			
1249							59.0		
								Dark Gray CARBONACEOUS SHALE With Thin Coal Seams, Thinly Laminated, Very Broken to Broken, Soft to Medium Hard .Coal Seams From 59.3-59.6', 60.1- 60.5', 63.5-65.0' .Traces of Pyrite .Claystone From 65.8-66.0' (RQD=0%)	
		0	5.0	4.6		62.0			
1242							66.0		
		14	5.0	4.9		67.0		Gray Laminated Fine-Grained SANDSTONE, Thinly Laminated to Very Thinly Bedded, Broken to Blocky, Medium Hard .Shaly Partings (RQD=36%)	
1236.3							71.7		
								Predominantly Gray SILTY SHALE With Occasional Sandy Laminations And Thin Beds of Sandstone, Thinly Laminated to Very Thinly Bedded, Broken to Blocky, Medium Hard	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Joe Durko
Drill Rig CME-55
Water Level: O-Hr. 88.2 24 Hrs. ____
Casing Hammer: Wt. ____ lbs. Drop ____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ JMA/TDW

Boring No. GB-5 Surface Elevation 1308.0 Sheet No. 4 of 5 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 03/28/12 Completed 03/30/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
								.Thin Coal Bed From 83.4-83.7'	
		26	10.0	10.0		77.0		(RQD=41%)	
		55	10.0	10.0		87.0			
		27	5.0	3.1		92.0			
1213.5							94.5		
1212.2		47	5.0	5.0		97.0	95.8	Dark Gray CARBONACEOUS SHALE, Very Intensely Laminated, Very Broken to Broken, Medium Hard .Vertical Fracture/Joint From 94.5-95.4' .Claystone From 95.4-95.8' (RQD=0%)	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Joe Durko
Drill Rig CME-55
Water Level: O-Hr. 88.2 24 Hrs. ____
Casing Hammer: Wt. ____ lbs. Drop ____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ JMA/TDW

Boring No. GB-5 Surface Elevation 1308.0 Sheet No. 5 of 5 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 03/28/12 Completed 03/30/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1205.3							102.7	Gray LIMESTONE, Thinly to Thickly Bedded, Broken to Massive, Hard to Very Hard (RQD=76%)	
1204							104.0	Gray CLAYSTONE (Calcareous), Indiscernible Bedding, Broken, Soft (RQD=0%)	
1201		56	10.0	10.0		107.0	107.0	Gray SILTY SHALE, Thinly Laminated, Broken to Blocky, Medium Hard (RQD=45%)	
1200.2							107.8	Dark Gray CARBONACEOUS SHALE, Thinly Laminated, Broken, Medium Hard .Traces of Pyrtie (RQD=50%)	
		42	5.0	5.0		112.0		Gray LIMESTONE With Claystone Beds, Thinly to Medium Bedded, Broken to Massive, Hard to Very Hard (Limestone), Soft to Very Soft (Claystone) .Claystone Beds From 109.8-110.7', 112.3-112.6', 113.4-114.2' .Beds From 110.7-112.0' And 112.6- 113.4' .Vertical Fracture From 115.5-116. 3' (RQD=42%)	
1188		43	8.0	8.0		120.0	120.0		
								Bottom of Boring @ 120.0'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. 4.4 24 Hrs. 13.2
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3½" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ TDW

Boring No. GB-18 Surface Elevation 1174.55 Sheet No. 1 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 06/04/12 Completed 06/04/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (FL)	DESCRIPTION	REMARKS
1174.55				1		0.0	TOPSOIL	
1174.05				2		0.5	Brown SILTY CLAY, Little Sand, Trace Gravel (Rock Fragments), Medium Stiff to Very Stiff, Damp	
				3	1.5			
				3				
				4			(Colluvial)	
				6	4.5			CL
				6				
				7				
				10	7.5			
1165.55						9.0		
				6			Brown CLAYEY GRAVEL (Rock Fragments), Little Sand, Little Silt, Medium Dense, Damp	
				8				
				14	10.5		(Residual)	
				10				
				8				
				31	13.5			
1159.55						15.0		
				19			Brown CLAYEY SAND (Rock Fragments), Little Gravel, Little to Trace Silt, Dense to Very Dense, Damp	
				20				
				24	16.5			
				13			.Rock Fragments Break Down Easily with Hand Pressure	
				18				
				23	19.5		(Residual)	
				25				
				40				
				36	22.5			
				16				
				20				

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. 4.4 24 Hrs. 13.2
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ TDW

Boring No. GB-18 Surface Elevation 1174.55 Sheet No. 2 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 06/04/12 Completed 06/04/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (FL)	DESCRIPTION	REMARKS
1149.55					19	25.5	25.0	Continued From Previous Page	
1147.55						27.0	27.0		
					50/.4			Gray SILTY GRAVEL (Shale And Limestone Fragments), Some Sand, Trace Clay, Very Dense, Dry	
1144.55							30.0	(Decomposed Shale And Limestone)	
								Gray LIMESTONE, Thinly Bedded, Broken, Hard	Top of Rock @ 30.0'
1142.55							32.0	.Vertical Fracture With Stains From 30.0-30.3' And 31.0-32.0'	
		0	3.0	2.3		33.0		(RQD=0%)	
								Gray CLAYSTONE, Indiscernible Bedding, Broken to Blocky, Very Soft .Shaly (Near Soil State) From 36.0-37.0' .Sparkly Mineral in Rock Mass	
1136.55		0	5.0	5.0		38.0	38.0	(RQD=0%)	
								Bottom of Boring @ 38.0'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. 2.8 24 Hrs. 2.7
Casing Hammer: Wt. ____ lbs. Drop ____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ JMA

Boring No. GB-19 Surface Elevation 1132.52 Sheet No. 1 of 1 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 06/04/12 Completed 06/05/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1132.52					1		0.0	TOPSOIL	
1132.02					1		0.5	Gray SILTY CLAY, Little Sand, Trace Gravel, Very Soft, Moist	.Moved Boring 5' Laterally And 2.5± Feet Lower in Elevation
					1	1.5			
								(Colluvial)	
1129.52							3.0		
					11			Brown SILTY CLAY, Some Sand, Trace Gravel (Rock Fragments), Hard, Damp	
					15				
					18	4.5			
								(Residual)	
1126.52							6.0		
					15			Dark Gray CLAYEY SAND, Little Gravel (Rock Fragments), Very Dense, Damp	
					22	7.2			
					50/.2				
								(Decomposed Carbonaceous Shale)	
1123.52							9.0		
					34	9.6		Black COAL With Thin Shale Seams	.Wet @ 9.0'
					50/.1				
					42	12.7			
					50/.2				
1117.52							15.0		
1117.12					50/.4	15.4	15.4	Decomposed SILTSTONE	
								Gray SILTSTONE Interbedded With SILTY SHALE, Thinly Laminated to Thickly Laminated, Very Broken to Blocky, Slightly Weathered, Medium Hard	Top of Rock @ 15.4' .Core Breaks Parallel With Bedding Planes
		19	2.6	2.4		18.0			
								(RQD=40%)	
1109.52		50	5.0	4.8		23.0	23.0		
								Bottom of Boring @ 23.0'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. 3.6 24 Hrs. 6.9
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ JMA

Boring No. GB-20 Surface Elevation 1124.92 Sheet No. 1 of 1 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 06/05/12 Completed 06/05/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (FL)	DESCRIPTION	REMARKS
1124.92					1		0.0	TOPSOIL	
1124.42					4		0.5	Brown SILTY CLAY, Some Sand, Trace Gravel (Rock Fragments), Stiff, Moist	
					4	1.5			
1122.92							2.0	(Colluvial)	
					3			Gray-Brown SILTY CLAY, Some Sand, Little Gravel (Rock Fragments), Stiff, Moist	
					4				
					6	4.5		(Residual)	
					4				
1117.92					6		7.0		
					12	7.5		Gray-Brown CLAYEY SAND, Little to Some Gravel (Rock Fragments), Some Silt, Dense to Very Dense, Damp	SC
					24				
					37				
					50/.4	10.4		(Decomposed Sandy Shale)	Becomes Increasing Coarser With Depth
					42	12.7			
					50/.2				
1109.52					50/.4	15.4	15.4		
		55	2.6	2.2		18.0		Dark Gray to Black Carbonaceous CLAYSHALE, Thickly Laminated to Thinly Bedded, Slightly to Moderately Weathered, Broken o Blocky, Soft (RQD=47%)	.Breaks Along Bedding Planes Top of Rock @ 15.4'
1104.92							20.0		
								Gray to Dark Gray With Black Streaks, Argillaceous LIMESTONE, Medium Bedded, Broken to Blocky, Slightly Weathered, Medium Hard to Hard	
1101.92		42	5.0	5.0		23.0	23.0	(RQD=44%)	
								Bottom of Boring @ 23.0'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. 4.8 24 Hrs. 9.2
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ JMA

Boring No. GB-21 Surface Elevation 1141.17 Sheet No. 1 of 1 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 06/06/12 Completed 06/06/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1141.17					1		0.0	TOPSOIL	
1140.67					1		0.5	Brown-Gray SILTY CLAY, Some Sand, Trace Gravel (Rock Fragments), Medium Stiff to Hard, Damp	
					4	1.5			
					8			(Residual)	
					22				
					25	4.5			
1134.67					6		6.5		
					8			Dark Gray to Black SILTY SAND, Trace Gravel, Little Clay, Dense, Damp	
					12	7.5			
								(Decomposed Carbonaceous Shale And Bony Coal)	
1131.67					13		9.5		
					18			Brown-Gray SILTY SAND, Little to Some Gravel (Sandstone Fragments), Trace Clay, Very Dense, Damp	
					45	10.5			
								(Residual)	
					50/.3	12.3			
1126.67							14.5		
1125.87							15.3	Light Gray SANDSTONE, Medium Bedded, Blocky, Hard	Top of Rock @ 14.5'
								(RQD=52%)	
								Black BONY COAL	
		14	3.0	1.7		17.5		(RQD=0%)	
1122.87							18.3		
								Gray SILTSTONE, Very Thinly Bedded, Blocky to Massive With Very Broken Seams, Moderately to Highly Weathered, Soft to Medium Hard	
								(RQD=63%)	
1118.67		53	5.0	4.8		22.5	22.5		
								Bottom of Boring @ 22.5'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. 4.9 24 Hrs. Backfilled
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ JMA

Boring No. GB-22 Surface Elevation 1154.25 Sheet No. 1 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 06/06/12 Completed 06/06/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1154.25					1		0.0	TOPSOIL	
1153.75					1		0.5	Brown-Gray SILTY CLAY, Some Sand, Little to some Gravel (Rock Fragments), Medium Stiff to Very Stiff, Damp to Moist	
					3	1.5			
					4			(Colluvial)	
					6				
					7	4.5			
					6				
					8				
					11	7.5			
					5				
					5				
					6	10.5			CL
					3				
					3				
					4	13.5			Moist @ 12.5'
1139.25							15.0		
					31			Gray SILTY SAND, Some Gravel (Sandstone Fragments), Little Clay, Very Dense, Damp	
					36				
					42	16.5		(Decomposed Sandstone)	
					50/.2	18.2			
1134.25							20.0		
								Gray to Dark Gray SILTY SHALE Grading Downward to Clayshale, Thinly to Thickly Laminated, Very Broken to Broken, Slightly Weathered, Soft to Medium Hard	Top of Rock @ 20.0'
		14	3.0	3.0		23.0		(RQD=0%)	Core Breakage Along Bedding Planes

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. 4.9 24 Hrs. Backfilled
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ JMA

Boring No. GB-22 Surface Elevation 1154.25 Sheet No. 2 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 06/06/12 Completed 06/06/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	ROD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1127.75							26.5		
1126.25		0	5.0	5.0		28.0	28.0	Black Bony COAL, Very Broken, Soft (RQD=0%)	
								Gray SILTSTONE	
								.9" Clay Shale Seam	
1121.25		0	5.0	5.0		33.0	33.0	(RQD=0%)	
								Gray SILTSTONE, Medium Bedded, Blocky to Massive, Slightly Weathered, Medium Hard	
1119.25		75	2.0	2.0		35.0	35.0	(RQD=75%)	
								Bottom of Boring @ 35.0'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart | Boring No. GB-23 | Surface Elevation 1173.23 | Sheet No. 1 of 2 sheets

Drill Rig BK-51 | For KGA Partners, LLC.

Water Level: O-Hr. 5.7 | 24 Hrs. Caved@16.3 | Meadows Landing

Casing Hammer: Wt. _____ lbs. Drop _____ in.

Sampler Hammer: Wt. 140 lbs. Drop 30 in. | Location South Strabane Twp., PA

Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D. | Started 06/06/12 | Completed 06/06/12 | Project No. 12022

Core Bit Size NQ2 | Driller's Log ☐ | Drilling Fluid Water

Orientation Vertical | Geologist's Log ☒ TDW

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1173.23					1		0.0	TOPSOIL	
1172.73					2		0.5	Brown SILTY CLAY, Little Sand, Trace to Little Gravel (Rock Fragments and Coal Pieces), Soft to Stiff, Moist	
					2	1.5			
					3				
					4				
					5	4.5		(Colluvial)	CL
					7				
					8				
					8	7.5			
1163.73					8		9.5		
					11			Brown-Gray CLAYEY SAND, Some Gravel (Rock Fragments), Little Silt, Dense to Very Dense, Damp	
					19	10.5			
					20				
					21			(Decomposed Sandy Shale)	
					38	13.5			
1157.53					38	15.7	15.7		
					50/.2			Gray Fine-Grained SANDSTONE Interbedded With SILTY SHALE, Thickly Laminated to Thinly Bedded, Broken to Massive, Slightly Weathered, Medium Hard	Top of Rock @ 15.7'
		36	2.3	1.9		18.0			
								(RQD=45%)	
		55	5.0	4.8		23.0			

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. 5.7 24 Hrs. Caved@16.3
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ TDW

Boring No. GB-23 Surface Elevation 1173.23 Sheet No. 2 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 06/06/12 Completed 06/06/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1140.23							25.0	Continued From Previous Page	
1145.23		40	5.0	5.0		28.0	28.0	Light Gray CLAYSHALE/CLAYSTONE, Indiscernible Bedding, Blocky to Massive, Slightly Weathered, Soft (RQD=66%)	
1141.73							31.5		
1140.23		70	5.0	5.0		33.0	33.0	Gray Argillaceous LIMESTONE, Blocky to Massive, Medium Bedded, Hard (RQD=66%)	
		45	5.0	5.0		38.0		Gray Calcareous CLAYSTONE, Indiscernible Bedding, Blocky to Massive, Slightly Weathered, Soft (RQD=38%)	
1133.23		20	2.0	2.0		40.0	40.0		
								Bottom of Boring @ 40.0'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. 19.1 24 Hrs.
Casing Hammer: Wt. ____ lbs. Drop ____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ TDW

Boring No. GB-24 Surface Elevation 1148.84 Sheet No. 1 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 06/05/12 Completed 06/06/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1148.84					1		0.0	TOPSOIL	
1148.34					1		0.5	Brown-Gray SILTY CLAY, Little Sand, Trace Gravel, Trace Coal Fragments, Soft to Stiff, Moist	
					2	1.5			
					3				
					5				
					4	4.5		(Colluvial)	
									CL
					4				Tried to Push Shelby Tube @ 7.0', Material Too Stiff to Sample
					6				
					10	7.5			
					8				
					5				Shelby Tube Sample From 9.0-10.5' (Rec. 0.8')
					4	10.5			
1136.84							12.0		
					8			Gray SILTY SAND, Little Gravel (Rock Fragments), Little Clay, Loose to Medium Dense, Damp	
					8				
					6	13.5			
								(Residual)	
					10				
					6				
					3	16.5			
1130.84							18.0		
1130.34							18.5	Light Gray, Medium-Grained SANDSTONE, Medium Bedded, Blocky, Slightly Weathered, Hard (RQD=83%)	Top of Rock @ 18.0'
								Gray SANDY Grading Into CLAYSHALE, Thickly Laminated to Thinly Bedded, Very Broken to Broken, Moderately Weathered, Soft	
		35	5.0	3.6		23.0			
								(RQD=30%)	
1124.84							24.0		
								See Next Page	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. 19.1 24 Hrs. ____
Casing Hammer: Wt. ____ lbs. Drop ____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ TDW

Boring No. GB-24 Surface Elevation 1148.84 Sheet No. 2 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 06/05/12 Completed 06/06/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1123.34							25.5	Dark Gray Carbonaceous CLAYSHALE, Thickly Laminated, Very Broken, Soft	
1122.34							26.5	(RQD=0%)	
		8	5.0	5.0		28.0		Black BONY COAL, Very Broken, Soft	
								(RQD=0%)	
								Gray SILTY SHALE With Carbonaceous Streaks, Thinly to Thickly Laminated, Broken, Slightly Weathered, Medium Hard	
1118.34							30.5		
								(RQD=5%)	
		15	5.0	5.0		33.0		Black BONY COAL With SHALY Seams, Very Broken to Broken, Soft	
1115.34							33.5	(RQD=0%)	
								Gray SILTSTONE With SILTY SHALE Interbeds, Thickly Laminated to Very Thinly Bedded, Very Broken to Massive, Slightly Weathered, Medium Hard	
		60	5.0	5.0		38.0		(RQD=56%)	
1105.84		47	5.0	5.0		43.0	43.0	Bottom of Boring @ 43.0'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. 6.2 24 Hrs. 9.2
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ TDW

Boring No. GB-25 Surface Elevation 1170.55 Sheet No. 1 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 06/06/12 Completed 06/06/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1170.55				1		0.0	TOPSOIL	
1170.05				2		0.5	Gray SILTY CLAY, Trace Sand,	
				2	1.5		Trace Gravel (Rock Fragments),	
							Medium Stiff to Very Stiff, Damp	
				5				
				8				
				9	4.5		(Residual)	
				4				
				6				
				7	7.5			
				7				
1160.55				7		10.0		
				12	10.5		Brown CLAYEY GRAVEL (Rock	
							Fragments), Some Sand, Some Silt,	
							Medium Dense to Very Dense, Damp	
				25				
				11				
				7	13.5			GC
							(Decomposed Siltstone)	
				7				
				4				
				11	16.5			
				31				
				50				
				33	19.5			
				25				
				36				
				27	22.5			
				39				
				50				

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. 6.2 24 Hrs. 9.2
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ TDW

Boring No. GB-25 Surface Elevation 1170.55 Sheet No. 2 of 2 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 06/06/12 Completed 06/06/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1145.55					50/.1	25.5	25.0	Continued From Previous Page	Top of Rock @ 25.1'
1145.05							25.5	Gray Fine-Grained SANDSTONE With SANDY SHALE Laminations, Calcareous Top 1 Foot, Thinly Laminated to Thinly Bedded, Slightly Weathered, Very Broken to Massive, Medium Hard to Hard	
		24	2.4	2.0		27.5		(RQD=27%)	
1138.05		27	5.0	5.0		32.5	32.5		
								Bottom of Boring @ 32.5'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. Dry 24 Hrs. ____
Casing Hammer: Wt. ____ lbs. Drop ____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size N/A Driller's Log ☐ ____
Orientation Vertical Geologist's Log ☒ JMA

Boring No. P-3 Surface Elevation 1114.6 Sheet No. 1 of 1 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 04/17/12 Completed 04/17/12 Project No. 12022
Drilling Fluid N/A

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1114.6						0.0		
1114.1				1		0.5	TOPSOIL	
				3			Brown Gray CLAYEY SAND, Some Silt, Trace Gravel (Rock Fragments), Loose to Medium Dense, Damp	
				4	1.5			
				5			(Residual)	
				6				
				8	4.5			
				9				
				10				
				11	7.5			
1106.6						8.0		
							Brown Gray SILTY GRAVEL, Little Sand, Trace Clay, Very Dense, Dry	
				50/.4	9.4			
							(Decomposed Sandstone)	
				11				
				17				
				50/.3	13.3			
1099.2				50/.4	15.4	15.4		
							Bottom of Boring @ 15.4'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. Dry 24 Hrs. ____
Casing Hammer: Wt. ____ lbs. Drop ____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size N/A Driller's Log ☐
Orientation Vertical Geologist's Log ☒ JMA

Boring No. P-4 Surface Elevation 1112.6 Sheet No. 1 of 1 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 04/17/12 Completed 04/17/12 Project No. 12022
Drilling Fluid N/A

ELEVATION	In-situ Tests and Instrumentation	ROD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1112.6				1		0.0	TOPSOIL	
1112.1				0		0.5	Brown Gray SILTY CLAY, Little Sand, Trace Gravel (Rock Fragments), Very Soft to Very Stiff, Damp to Moist	
				3	1.5			
				4			(Residual)	
				5				
				8	4.5			
				10				
				10				
				14	7.5			
				6				
1102.6				8		10.0		
				28	10.5		Brownish Gray SILTY GRAVEL, Some Sand, Little Clay, Dense to Very Dense, Dry	
				19			(Decomposed Sandstone)	
				35				
				50/.4	13.4			
1097.5						15.1		
				50/.1	15.1		Bottom of Boring @ 15.1'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. 2.7 24 Hrs. 5.9
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ JMA

Boring No. P-7 Surface Elevation 1115.8 Sheet No. 1 of 1 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 06/18/12 Completed 06/18/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1115.8					1		0.0	TOPSOIL	
1115.3					3		0.5	Brown-Gray Mottled SILTY CLAY, Trace to Little Sand, Trace Rock Fragments, Stiff to Very Stiff, Damp to Moist	
					7	1.5			
					10				
					9				
					11	4.5		(Residual)	
					5				
					7				
					10	7.5			
					5				
					8				
					11	10.5			
1103.8							12.0		
					50/.3	12.3		Brown-Gray CLAYEY SAND, Little Shale Fragments, Little Silt, Very Dense, Damp	
								(Decomposed Shale)	
1100.4					50/.4	15.4	15.4		
								Gray Fine-Grained SANDSTONE With SANDY SHALE Interbeds, Thinly Bedded, Very Broken to Blocky, Weathered and Soft 1 Foot, Medium Hard Below	Top of Rock @ 15.4'
		26	2.6	2.4		18.0			
								(RQD=24%)	
1094.8		22	3.0	3.0		21.0	21.0		
								Bottom of Boring @ 21.0'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Hart
Drill Rig BK-51
Water Level: O-Hr. 2.8 24 Hrs. 5.5
Casing Hammer: Wt. _____ lbs. Drop _____ in.
Sampler Hammer: Wt. 140 lbs. Drop 30 in.
Sampler Size 2 in. O.D. Casing Size 3¼" in. I.D.
Core Bit Size NQ2 Driller's Log ☐
Orientation Vertical Geologist's Log ☒ JMA

Boring No. P-8 Surface Elevation 1118.2 Sheet No. 1 of 1 sheets
For KGA Partners, LLC.
Meadows Landing
Location South Strabane Twp., PA
Started 06/18/12 Completed 06/18/12 Project No. 12022
Drilling Fluid Water

ELEVATION	In-situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
1118.2					2		0.0	TOPSOIL	
1117.7					2		0.5	Brown SILTY CLAY, Little Sand,	
					4	1.5		Trace Rock Fragments, Medium	
								Stiff to Stiff, Damp	
					5				
					8				
					10	4.5			
					6				
					7				
					7	7.5			
1109.2							9.0		
					15			Gray-Brown SILTY CLAY, Trace	
					14			Sand, Very Stiff, Damp	
					15	10.5			
								(Residual)	
1106.2							12.0		
					50/.3	12.3		Grayish-Brown CLAYEY SAND, Little	
								Shale Fragments, Little Silt,	
								Very Dense, Damp	
								(Decomposed Shale)	
1102.8					50/.4	15.4	15.4		
								Gray Fine-Grained SANDSTONE With	Top of Rock @ 15.4'
								SANDY SHALE, Thinly Bedded	
								Interbeds, Broken to Blocky,	
		19	2.6	2.6		18.0		Medium Hard	
								(RQD=40%)	
1097.2		58	3.0	3.0		21.0	21.0		
								Bottom of Boring @ 21.0'	

APPENDIX A-2:

Relevant ACA Test Boring Records
2006 and 2011 Geotechnical Investigations
B-1 through B-6 (2011)
B-2, B-4, B-5, B-6 (2006)

Project No: PC60231x10

Project: Route 19 Property

Client: KGA Partners

Location: Washington, PA

ACA Engineering, Inc.

Borehole #: B-3

Elevation: 1015' +/-

Engineer/Geologist: J. Mostren-Williams

SUBSURFACE PROFILE				SAMPLE							
Depth	Symbol	Description	Depth/Elev.	Number	Type	Sample Depth	Blows/ft	Recovery	N Value blows/ft (10 30 50)	Water Level	Remarks
0		Ground Surface									
1		Topsoil - 4"	0.0	S-1	SS	0.0 - 1.5	2 5 6	1.5			Moist
2		Stiff brown silty CLAY with trace rock fragments, sand, and organics (CL)									
3		Very stiff brown clayey SILT with rock fragments (ML)	2.5	S-2	SS	3.0 - 4.5	6 6 14	1.1			Dry
5		Completely to highly weathered brown SANDSTONE	5.0	S-3	SS	6.0 - 7.5	18 21 24	1.5			Dry
8		Completely weathered brown silty SHALE	8.0	S-4	SS	9.0 - 10.5	7 9 28	1.5			Dry
10		Completely weathered reddish-brown SANDSTONE	10.0								
12		Completely weathered brown silty SHALE	12.5	S-5	SS	12.0 - 13.5	16 16 11	1.5			Dry
15		Completely to highly weathered gray SANDSTONE	15.5	S-6	SS	15.0 - 16.5	21 30 41	1.5			Dry
17		Completely to highly weathered brown sandy SHALE	17.0	S-7	SS	18.0 - 18.8	47 50-3"	0.8			Dry
20											

Drilled By: Test Boring Services, Inc.

Drill Method: Hollow Stem Auger

Drill Date: September 25, 2006

ACA Engineering, Inc.
40 Western Avenue
Pittsburgh, PA 15202
Phone: (412) 761-1990

Hole Size: 5"

Weather: Sunny - 70's

Sheet: 1 of 2

Project No: P060231x10

Project: Route 19 Property

Client: KGA Partners

Location: Washington, PA

ACA Engineering, Inc.

Borehole #: B-3

Elevation: 1315' +/-

Engineer/Geologist: J. Masten Williams

SUBSURFACE PROFILE				SAMPLE							
Depth	Symbol	Description	Depth/Elev.	Number	Type	Sample Depth	Blows/ft	Recovery	N-Value blows/ft 10 30 50	Water Level	Remarks
21				S-8	SS	21.0 - 21.7	31 50-2"	3.9			Dry
22		End of Test Boring	21.7								
23											
24											
25											
26											
27											
28											
29											
30											
31											
32											
33											
34											
35											
36											
37											
38											
39											
40											

Drilled By: Test Boring Services, Inc.

Drill Method: Hollow Stem Auger

Drill Date: September 25, 2006

ACA Engineering, Inc.
40 Western Avenue
Pittsburgh, PA 15202
Phone: (412) 761-1990

Hole Size: 5"

Weather: Sunny - 70's

Sheet: 2 of 2

Project No: P060231x10

Project: Route 18 Property

Client: KGA Partners

Location: Washington, PA

ACA Engineering, Inc.

Borehole #: B-4

Elevation: 1220' +/-

Engineer/Geologist: J. Mastron-Williams

SUBSURFACE PROFILE				SAMPLE							
Depth	Symbol	Description	Depth/Elev.	Number	Type	Sample Depth	Blowsft	Recovery	N-Value blows/ft 10 30 50	Water Level	Remarks
0		Ground Surface									
0		Topsoil - 4"	0.0								
1		Stiff brown silty CLAY with rock fragments (CL)		S-1	SS	0.0 - 1.5	2 5 6	1.5			Moist
3		Completely weathered COAL	3.0								
4			4.0	S-2	SS	3.0 - 4.5	7 6 8	1.5			Moist
6		Completely to highly weathered grayish-brown sandy SHALE		S-3	SS	6.0 - 7.5	9 12 17	1.2			Dry
9				S-4	SS	9.0 - 10.5	4 9 13	1.4			Dry
12			11.5								
12		Highly weathered gray sandy SHALE		S-5	SS	12.0 - 13.1	24 37 50-1"	1.1			Dry
15				S-6	SS	15.0 - 15.1	50-1"	0.0			Dry
15		End of Test Boring	15.6								
16											
17											
18											
19											
20											

Drilled By: Test Boring Services, Inc.

Drill Method: Hollow Stem Auger

Drill Date: September 27, 2006

ACA Engineering, Inc.
40 Western Avenue
Pittsburgh, PA 15202
Phone: (412) 761-1990

Hole Size: 5"

Weather: Sunny - 70's

Sheet: 1 of 1

Project No: P060231x10

Project: Route 19 Property

Client: KGA Partners

Location: Washington, PA

ACA Engineering, Inc.

Borehole #: B-5

Elevation: 1235' +/-

Engineer/Geologist: J. Mastren-Williams

SUBSURFACE PROFILE				SAMPLE							
Depth	Symbol	Description	Depth/Elev.	Number	Type	Sample Depth	Blows/ft	Recovery	N-Value blows/ft (10 30 50)	Water Level	Remarks
0		Ground Surface									
0		Topsoil - 5"	0.0	S-1	SS	1.0 - 1.5	3 8 10	1.5			Moist
1		Very stiff brown silty CLAY with rock fragments and sand (CL)									
2											
3											
4				S-2	SS	3.0 - 4.5	5 17 23	0.7			Moist
4		Completely weathered gray SANDSTONE	4.0								
5											
6			5.5								
6				S-3	SS	6.0 - 7.5	14 18 21	1.5			Dry
7											
8											
9		Completely to highly weathered gray silty to sandy SHALE									
10				S-4	SS	9.0 - 10.5	13 43 45	1.5			Dry
11											
12											
13				S-5	SS	12.0 - 13.2	20 40 50-2"	1.0			Dry
13			13.2								
14											
15				R-1	Core	13.2 - 16.5		2.5			
16		Very soft to medium, gray sandy SHALE with gray SANDSTONE layers, very broken to massive RQD=28%									
17											
18											
19				R-2	Core	16.5 - 21.5		4.9			
20											

Drilled By: Test Boring Services, Inc.

Drill Method: Hollow Stem Auger

Drill Date: September 26, 2006

ACA Engineering, Inc.
40 Western Avenue
Pittsburgh, PA 15202
Phone: (412) 761-1990

Hole Size: 5"

Weather: Sunny - 70's

Sheet: 1 of 2

Project No: P060231x10

Project: Route 18 Property

Client: KGA Partners

Location: Washington, PA

Engineering, Inc.

Borehole #: B-5

Elevation: 1235' +/-

Engineer/Geologist: J. Mastren-Williams

SUBSURFACE PROFILE				SAMPLE							
Depth	Symbol	Description	Depth/Elev.	Number	Type	Sample Depth	Blows/ft	Recovery	N-Value blows/ft 10 30 50	Water Level	Remarks
21											
22			21.4								
23		Medium-hard, gray SANDSTONE, broken to massive RQD=66%									
24				R-3	Core	21.5 - 26.5		5.0			
25			24.2								
26											
27											
28		Very soft to medium, gray sandy SHALE, very broken to massive RQD=22%									
29				R-4	Core	26.5 - 31.5		5.0			
30											
31											
32				R-5	Core	31.5 - 32.0		0.5			
33			32.0								
34											
35				R-6	Core	32.0 - 37.0		5.0			
36		Medium hard to hard, gray SILTSTONE, very broken to massive RQD - 51%									
37											
38											
39				R-7	Core	37.0 -40.0		3.0			
40			40.0								

Drilled By: Test Boring Services, Inc.

Drill Method: Hollow Stem Auger

Drill Date: September 28, 2006

ACA Engineering, Inc.
40 Western Avenue
Pittsburgh, PA 15202
Phone (412) 761-1990

Hole Size: 5"

Weather: Sunny - 70's

Project No: P060231x10

Project: Route 19 Property

Client: KGA Partners

Location: Washington, PA

ACA Engineering, Inc.

Borehole #: B-7

Elevation: 1255' +/-

Engineer/Geologist: J. Mastren-Williams

SUBSURFACE PROFILE				SAMPLE						
Depth	Symbol	Description	Depth/Elev.	Number	Type	Sample Depth	Blows/ft	Recovery	N-Value blows/ft (10 30 50)	Water Level	Remarks
0		Ground Surface									
0		Topsoil - 4"	0.0				1				
1		Stiff brown silty CLAY with rock fragments, sand, and organics (CL)		S-1	SS	0.0 - 1.5	3 4	1.1			Moist
2			2.0								
3		Stiff brown silty CLAY with rock fragments (CL)					4				
4				S-2	SS	3.0 - 4.5	4 11	1.5			Moist
5			5.0								
6		Stiff gray clayey SILT with rock fragments (ML)					5				
7				S-3	SS	6.0 - 7.5	7 3	0.7			Moist
8			7.0								
9		Stiff brown silty CLAY with rock fragments (CL)					17				
10				S-4	SS	9.0 - 10.5	17 18	0.5			Moist
11			10.0								
12							16				
13				S-5	SS	12.0 - 13.5	17 9	1.5			Dry
14		Completely to highly weathered gray SILTSTONE									
15							16				
16				S-6	SS	15.0 - 16.5	20 23	1.5			Dry
17											
18			18.2				37				
19				S-7	SS	18.0 - 19.5	41 37	1.5			Dry
20											

Drilled By: Test Boring Services, Inc.

Drill Method: Hollow Stem Auger

Drill Date: September 25, 2006

ACA Engineering, Inc.
40 Western Avenue
Pittsburgh, PA 15202
Phone: (412) 761-1990

Hole Size: 5"

Weather: Sunny - 70's

Sheet: 1 of 3

Project No: P060231x10

Project: Route 19 Property

Client: KGA Partners

Location: Washington, PA

ACA Engineering, Inc.

Borehole #: B-7

Elevation: 1265' +/-

Engineer/Geologist: J. Mastren-Williams

SUBSURFACE PROFILE				SAMPLE							
Depth	Symbol	Description	Depth/Elev.	Number	Type	Sample Depth	Blows/ft	Recovery	N-Value blows/ft (10 30 50)	Water Level	Remarks
21		Completely to highly weathered black carbonaceous SHALE with layers of coal		S-8	SS	21.0 - 22.5	15 23 21	1.5			Dry
22											
23											
24			23.5								
25		Hard, gray silty SHALE, very broken to blocky RQD=0%		S-9	SS	24.0 - 24.9	22 50/4"	0.7			Wet
26				R-1	Core	25.0 - 27.0		2.0			
27			27.0								
28		Soft to medium-hard, gray sandy SHALE, very broken to blocky RQD=6%									
29											
30				R-2	Core	27.0 - 32.0		5.0			
31											
32			32.0								
33		Hard, gray silty SHALE, very broken to blocky RQD=15%						4.5			
34			34.0								
35				R-3	Core	32.0 - 37.0		4.5			
36											
37											
38											
39											
40				R-4	Core	37.0 - 42.0		4.8			

Drilled By: Test Boring Services, Inc.

Drill Method: Hollow Stem Auger

Drill Date: September 25, 2006

ACA Engineering, Inc.
40 Western Avenue
Pittsburgh, PA 15202
Phone: (412) 761-1990

Hole Size: 5"

Weather: Sunny - 70's

Project No: P060231x10

Project: Route 19 Property

Client: KGA Partners

Location: Washington, PA

ACA Engineering, Inc.

Borehole #: B-7

Elevation: 1255' +/-

Engineer/Geologist: J. Mastren-Williams

SUBSURFACE PROFILE				SAMPLE							
Depth	Symbol	Description	Depth/Elev.	Number	Type	Sample Depth	Blows/ft	Recovery	N-Value blows/ft 10 30 50	Water Level	Remarks
41		Soft to hard, gray sandy SHALE with SANDSTONE layers, very broken to massive RQD=17%		R-5	Core	42.0 - 47.0		5.0			
42											
43											
44											
45											
46											
47			47.2								
48		Hard to very hard, gray SILTSTONE, very broken to massive RQD-35%		R-6	Core	47.0 - 52.0		4.0			
49											
50											
51											
52											
53				R-7	Core	52.0 - 55.5		3.5			
54											
55											
56											
57				R-8	Core	55.5 - 60.0		5.0			
58											
59											
60			60.0								

Drilled By: Test Boring Services, Inc.

Drill Method: Hollow Stem Auger

Drill Date: September 25, 2006

ACA Engineering, Inc.
40 Western Avenue
Pittsburgh, PA 15202
Phone: (412) 761-1990

Hole Size: 5"

Weather: Sunny - 70's

Project No: P060231x10

Project: Route 19 Property

Client: KSA Partners

Location: Washington, PA

ACA Engineering, Inc.

Borehole #: B-8

Elevation: 1230' +/-

Engineer/Geologist: J. Mastren-Williams

SUBSURFACE PROFILE				SAMPLE							
Depth	Symbol	Description	Depth/Elev	Number	Type	Sample Depth	Blows/ft	Recovery	N-Value blows/ft 10 30 50	Water Level	Remarks
0		Ground Surface									
0		Topsoil - 4"	0.0								
1		Firm brown silty CLAY with rock fragments and organics (CL)		S-1	SS	0.0 - 1.5	1 2 3	1.5			Moist
2											
3		Completely weathered COAL	2.5								
4				S-2	SS	3.0 - 4.5	4 8 9	0.8			Moist
5			4.0								
6											
7		Completely to highly weathered black carbonaceous SHALE with coal layers		S-3	SS	6.0 - 7.5	6 10 14	1.5			Moist
8											
9											
10				S-4	SS	9.0 - 10.5	11 13 14	1.4			Dry
11											
12			12.5								
13				S-5	SS	12.0 - 12.7	27 50-2"	0.5			Dry
14		Completely weathered gray sandy SHALE									
15				S-6	SS	15.0 - 15.8	17 50-3"	0.4			Dry
16											
17											
18		End of Test Boring	17.8								
19											
20											

Drilled By: Test Boring Services, Inc.

Drill Method: Hollow Stem Auger

Drill Date: September 27, 2006

ACA Engineering, Inc.
40 Western Avenue
Pittsburgh, PA 15202
Phone: (412) 761-1990

Hole Size: 5"

Weather: Sunny - 70's

Sheet: 1 of 1

Project No: P060231x10

Project: Route 19 Property

Client: KGA Partners

Location: Washington, PA

ACA Engineering, Inc.

Borehole #: B-9

Elevation: 1215' +/-

Engineer/Geologist: J. Mastren-Williams

SUBSURFACE PROFILE				SAMPLE							
Depth	Symbol	Description	Depth/Elev.	Number	Type	Sample Depth	Blows/ft	Recovery	N-Value blows/ft (10 30 50)	Water Level	Remarks
0		Ground Surface									
0		Topsoil - 1"	0.0	S-1	SS	0.0 - 1.5	4 3 5	0.9			Moist
2		Firm brown sandy SILT with rock fragments (ML)									
4			4.0	S-2	SS	3.0 - 4.5	5 5 6	1.5			Moist
6		Stiff to very stiff gray silty CLAY with rock fragments (CL)		S-3	SS	6.0 - 7.5	6 5 8	0.8			Moist
8			9.0								
10		Very stiff brown silty CLAY with rock fragments (CL)		S-4	SS	9.0 - 10.5	10 13 13	1.5			Moist
12				S-5	SS	12.0 - 13.5	12 15 15	1.5			Moist
14			13.0								
16		Completely weathered gray silty SHALE		S-6	SS	15.0 - 16.5	15 10 22	1.5			Dry
18			18.5								
20		Completely weathered gray SILTSTONE	20.0	S-7	SS	18.5 - 20.0	15 10 18	1.0			Dry

Drilled By: Test Boring Services, Inc.

Drill Method: Hollow Stem Auger

Drill Date: September 26, 2006

ACA Engineering, Inc.
40 Western Avenue
Pittsburgh, PA 15202
Phone: (412) 761-1990

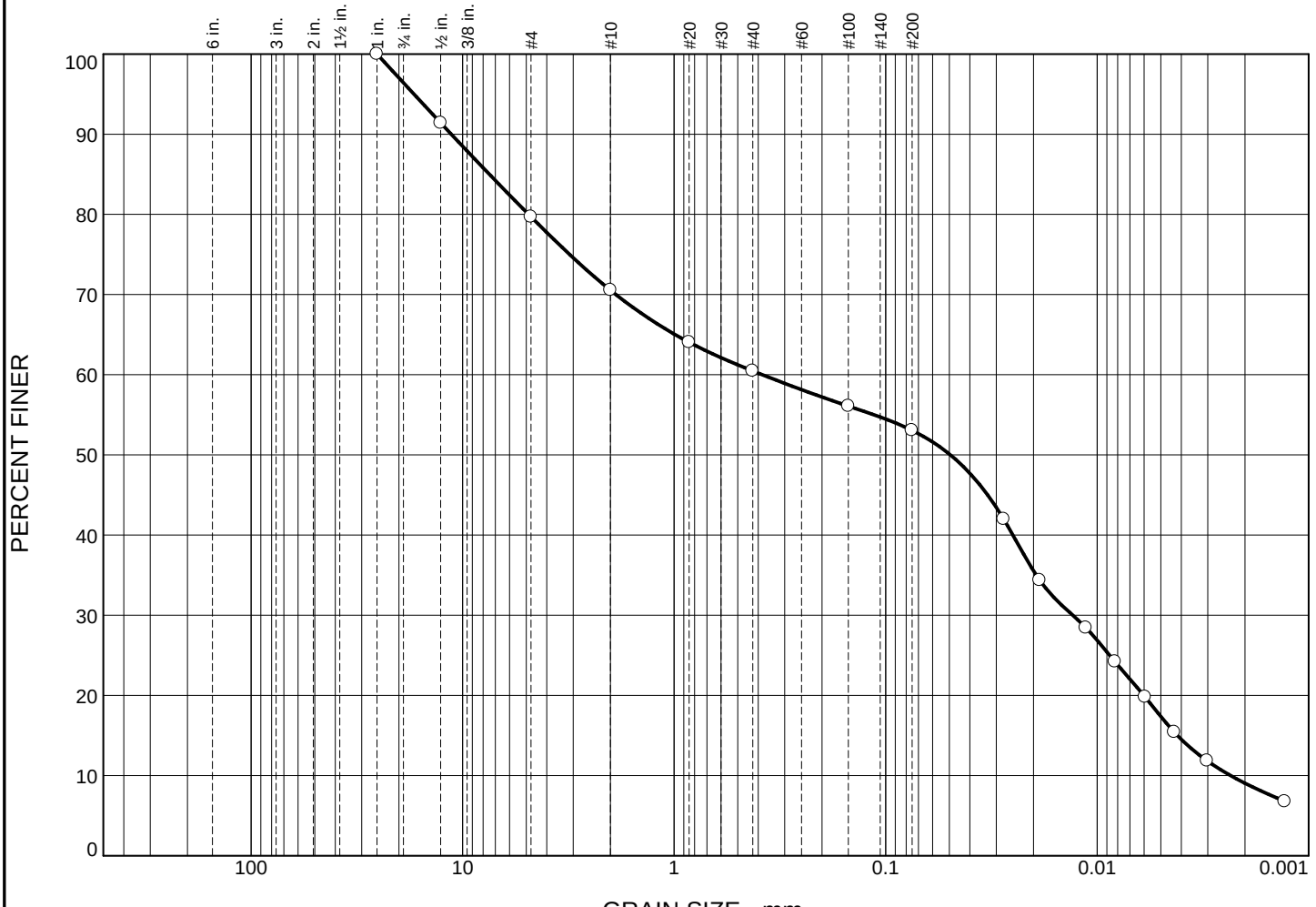
Hole Size: 5"

Weather: Sunny - 70's

Sheet: 1 of 1

APPENDIX B
Laboratory Tests Results
Current Investigation

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	3.6	16.7	9.2	10.0	7.4	35.7	17.4

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	33	21	7.4746	0.3828	0.0494	0.0130	0.0042	0.0023	0.19	163.52

Material Description	USCS	AASHTO
○ Moderately Plastic Silty Clay, Some Sand, Some Gravel, Damp (Residual)	CL	A-6(4)

Project No. 21016 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

○ **Source of Sample:** TB-2 **Depth:** 9.0'-12.7'

Remarks:

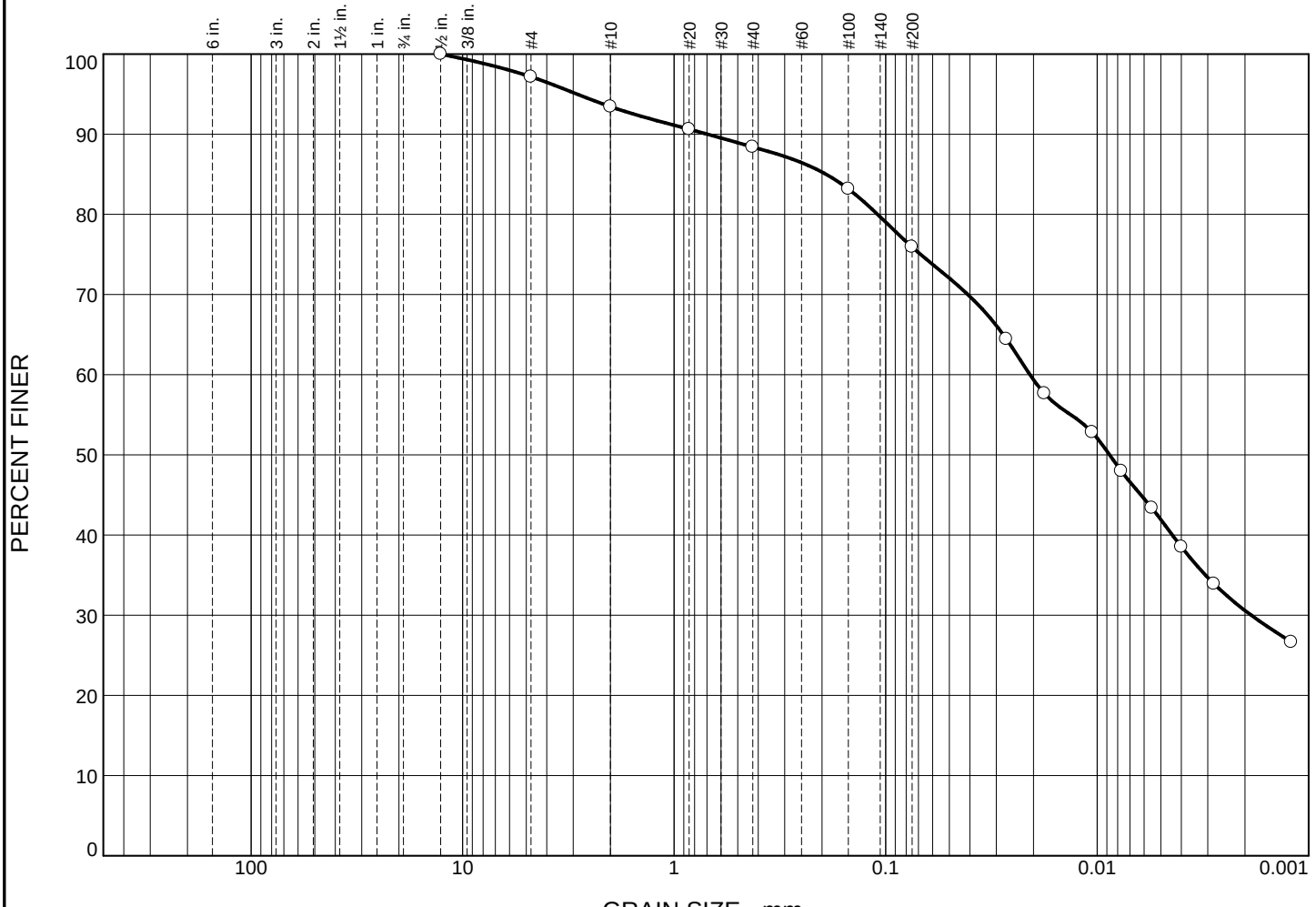
○N.W.C.= 8.7%

JAR SAMPLES

GEO-MECHANICS, INC.

Figure B-1

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	2.8	3.8	5.0	12.5	34.0	41.9

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	45	20	0.1912	0.0208	0.0087	0.0019				

Material Description	USCS	AASHTO
○ Moderately Plastic Silty Clay, Some Sand, Trace Gravel, Moist (Residual)	CL	A-7-6(18)

Project No. 21016 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

○ **Source of Sample:** TB-3 **Depth:** 6.0'-10.5'

Remarks:

○N.W.C.= 19.1%

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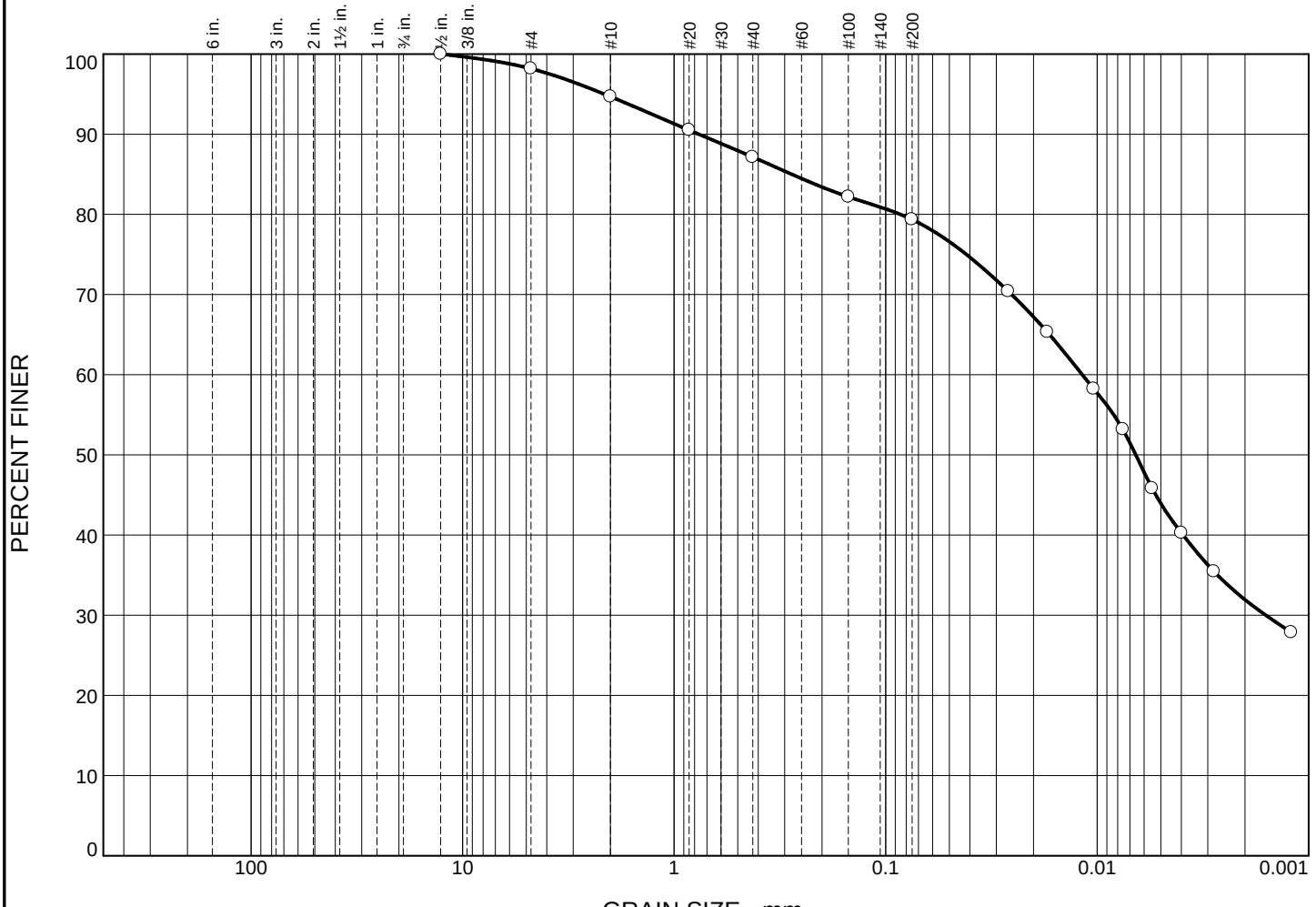
Figure B-2

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.8	3.5	7.6	7.7	35.5	43.9

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	34	17	0.2779	0.0118	0.0066	0.0016				

Material Description	USCS	AASHTO
○ Moderately Plastic Silty Clay, Little Sand, Trace Gravel, Damp (Residual)	CL	A-6(12)

Project No. 21016 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

○ **Source of Sample:** TB-5 **Depth:** 3.0'-12.0'

Remarks:

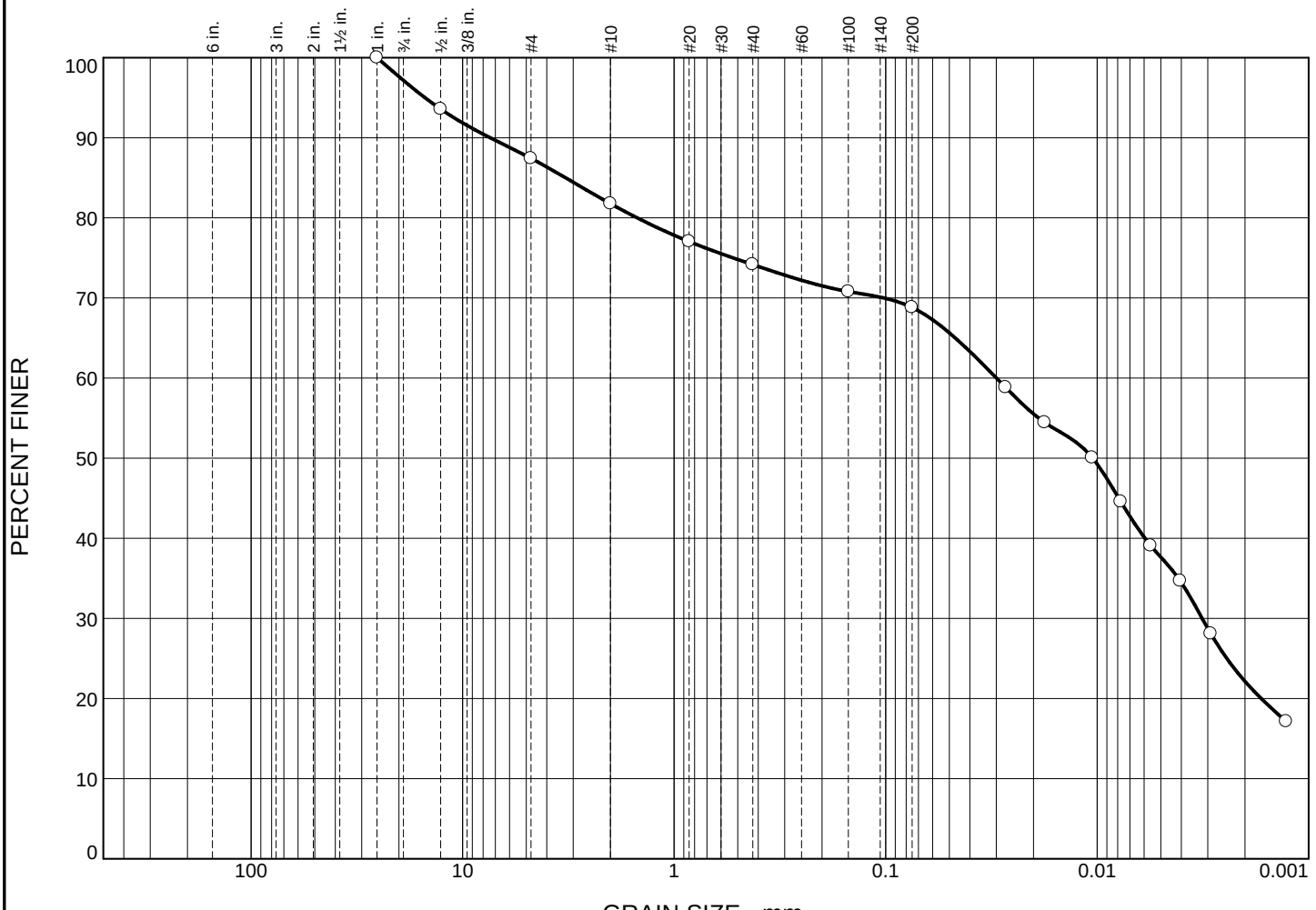
○N.W.C.= 7.3%

BAG SAMPLE

GEO-MECHANICS, INC.

Figure B-3

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	2.8	9.8	5.6	7.6	5.4	31.2	37.6

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	44	22	3.2594	0.0299	0.0105	0.0032				

Material Description	USCS	AASHTO
○ Moderately Plastic Silty Clay, Little Sand, Little Gravel, Moist (Residual)	CL	A-7-6(14)

Project No. 21016 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

○ **Source of Sample:** TB-6 **Depth:** 3.0'-7.5'

Remarks:

○N.W.C.= 17.0%

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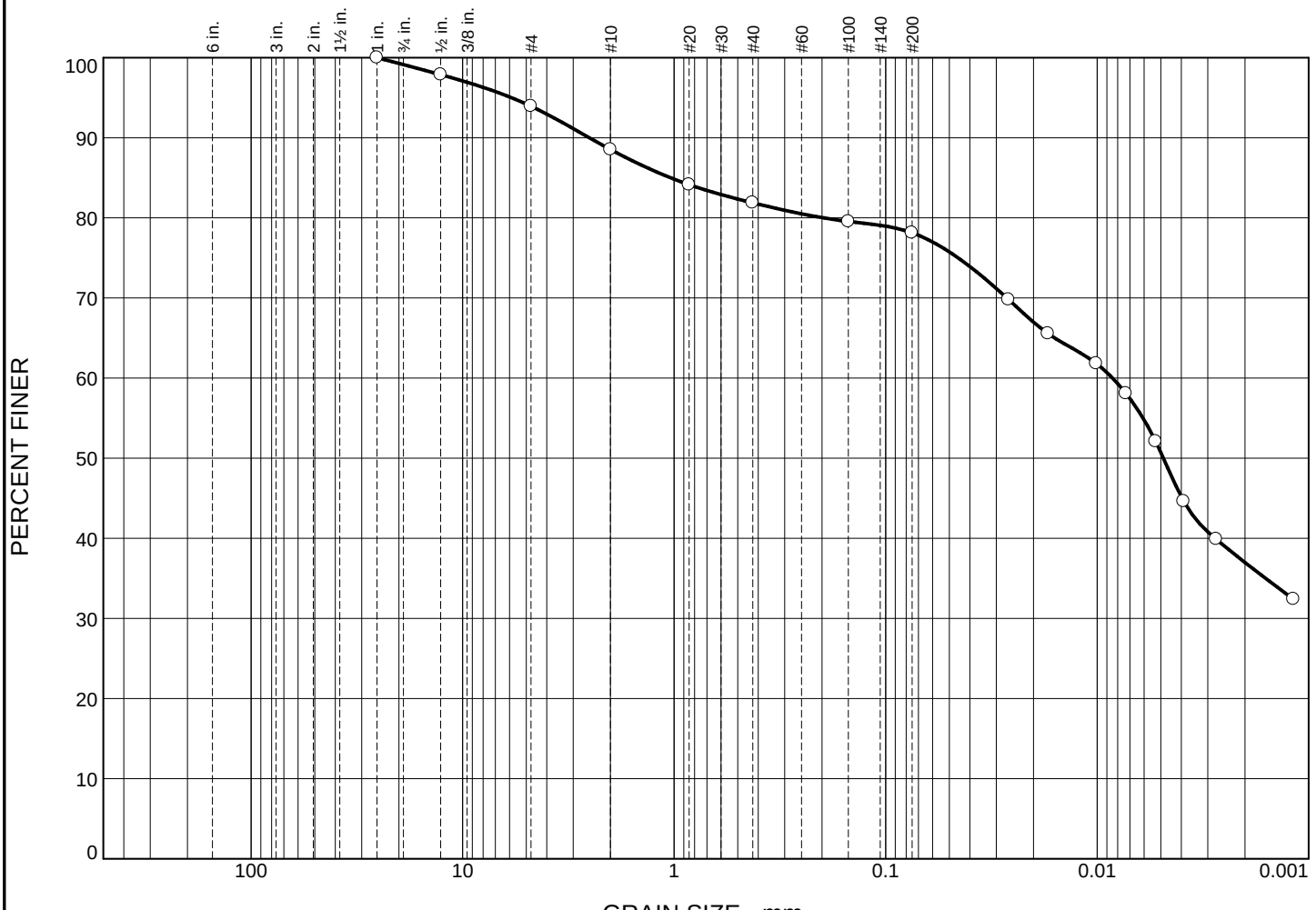
GEO-MECHANICS, INC.

Figure B-4

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.9	5.2	5.4	6.6	3.8	27.4	50.7

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	42	22	1.0378	0.0085	0.0049					

Material Description	USCS	AASHTO
○ Moderately Plastic Silty Clay, Little Sand, Trace Gravel, Moist (Residual)	CL	A-7-6(15)

Project No. 21016 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

○ **Source of Sample:** TB-8 **Depth:** 3.0'-7.5'

Remarks:

○N.W.C.= 16.9%

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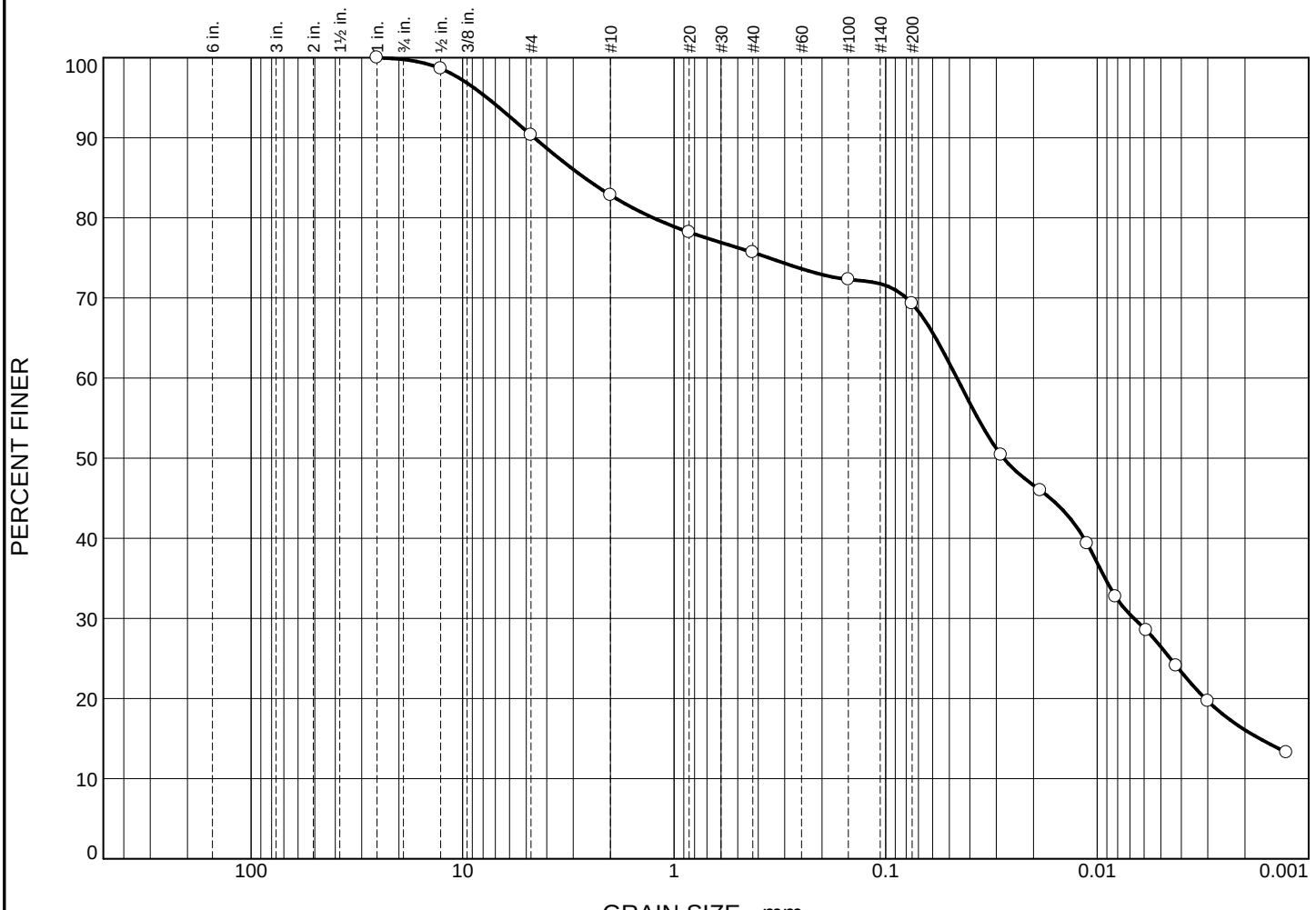
Figure B-5

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.2	9.5	7.5	7.1	6.4	42.8	26.5

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	36	20	2.6480	0.0460	0.0277	0.0067	0.0017			

Material Description	USCS	AASHTO
○ Moderately Plastic Silty Clay, Some Sand, Trace Gravel, Damp (Colluvial)	CL	A-6(9)

Project No. 21016 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

○ **Source of Sample:** TB-9 **Depth:** 3.0'-7.5'

Remarks:

○N.W.C.= 14.6%

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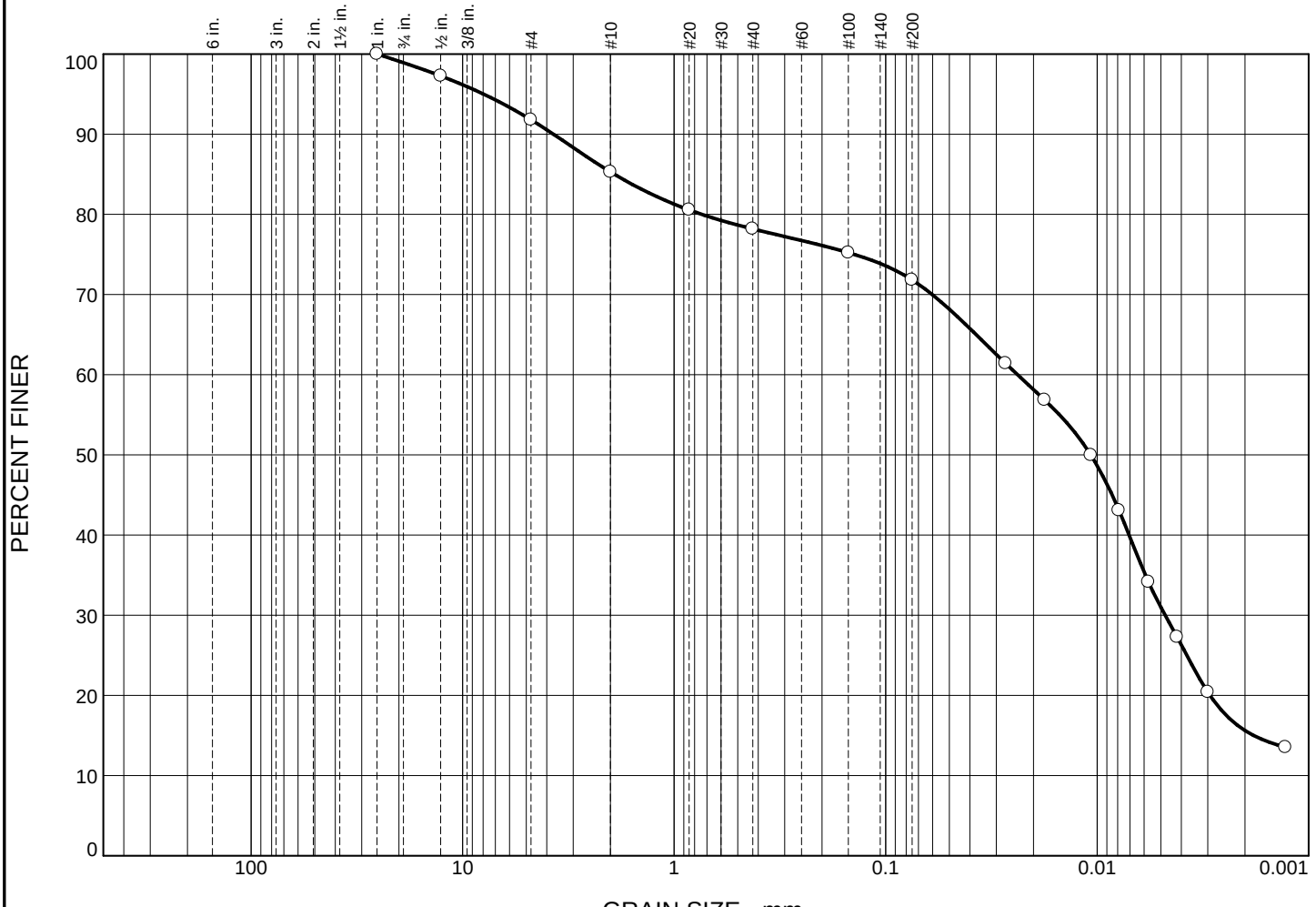
GEO-MECHANICS, INC.

Figure B-6

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	1.1	7.1	6.5	7.1	6.4	40.8	31.0

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	41	23	1.9163	0.0238	0.0107	0.0048	0.0018			

Material Description	USCS	AASHTO
○ Moderately Plastic Silty Clay, Some Sand, Trace Gravel, Moist (Colluvial)	CL	A-7-6(12)

Project No. 21016 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

○ **Source of Sample:** TB-10 **Depth:** 3.0'-7.5'

Remarks:

○N.W.C.= 18.6%

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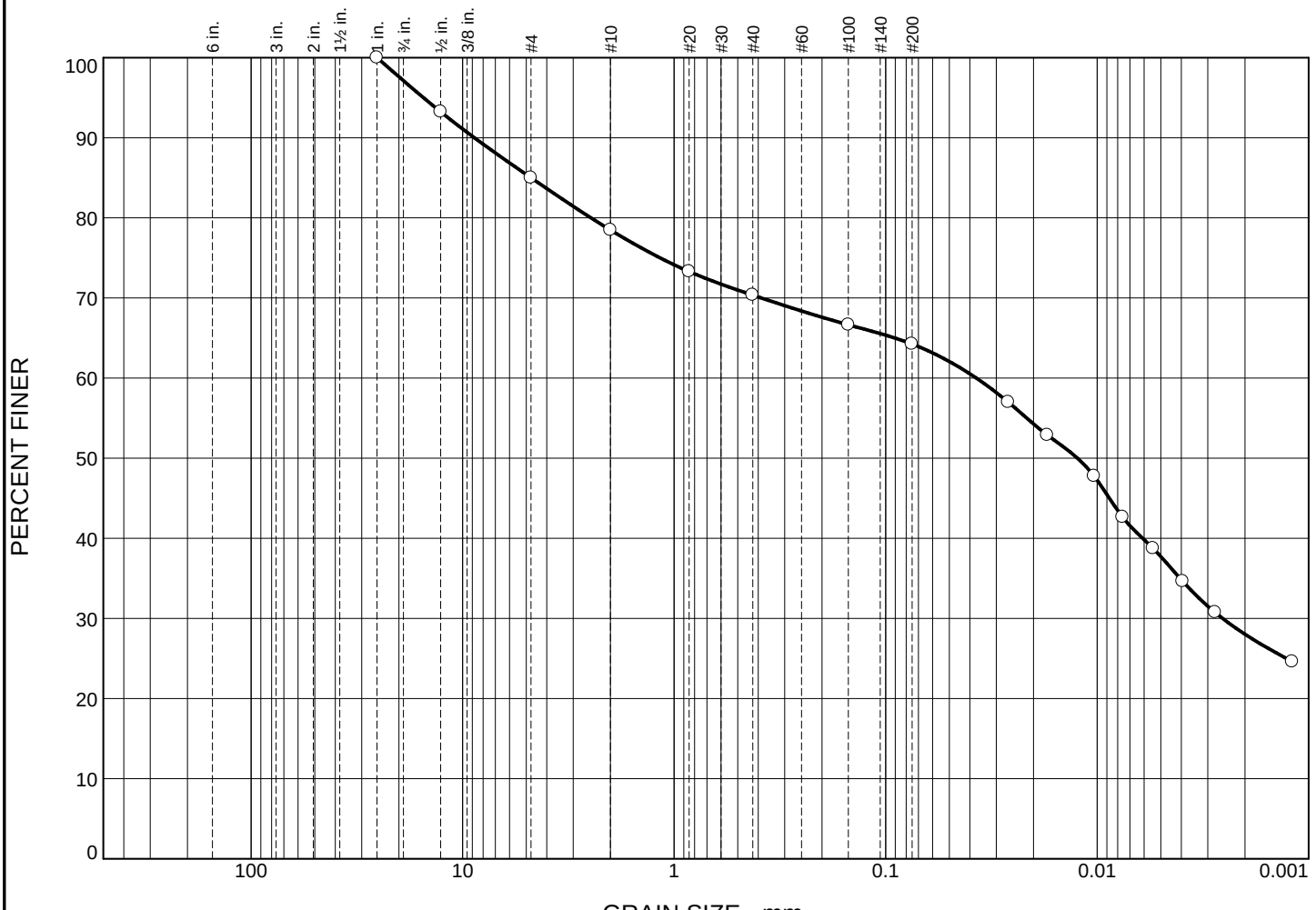
Figure B-7

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	2.9	12.1	6.5	8.1	6.2	26.5	37.7

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	46	23	4.7492	0.0373	0.0124	0.0026				

Material Description	USCS	AASHTO
○ Moderately Plastic Silty Clay, Some Sand, Little Gravel, Moist (Colluvial)	CL	A-7-6(13)

Project No. 21016 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

○ **Source of Sample:** TB-14 **Depth:** 3.0'-7.5'

Remarks:

○N.W.C.= 18.2%

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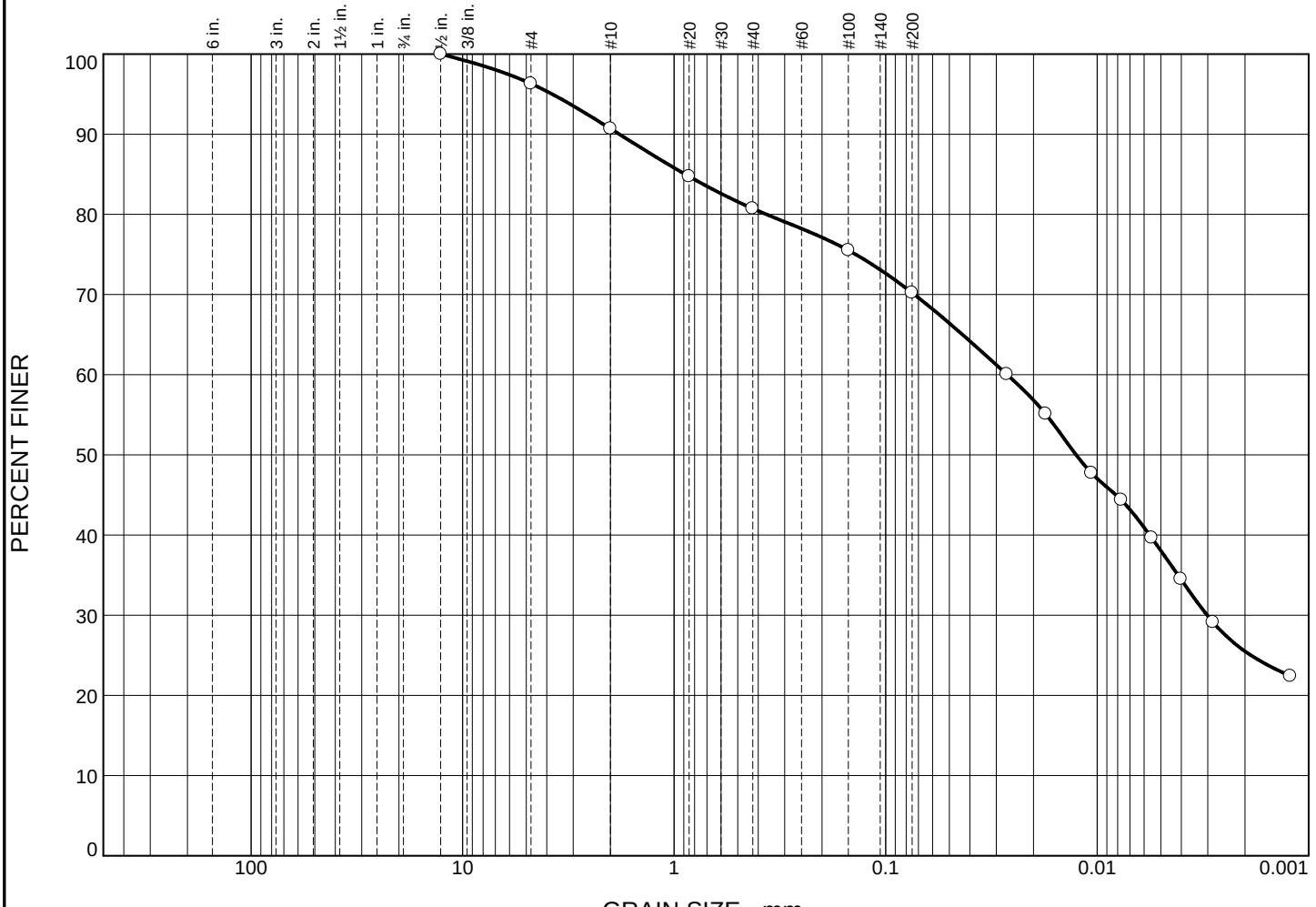
GEO-MECHANICS, INC.

Figure B-8

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	3.7	5.6	10.0	10.5	32.1	38.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	34	18	0.8862	0.0266	0.0126	0.0030				

Material Description	USCS	AASHTO
○ Moderately Plastic Silty Clay, Some Sand, Trace Gravel, Dry (Residual)	CL	A-6(9)

Project No. 21016 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

○ **Source of Sample:** TB-15 **Depth:** 3.0'-18.0'

Remarks:

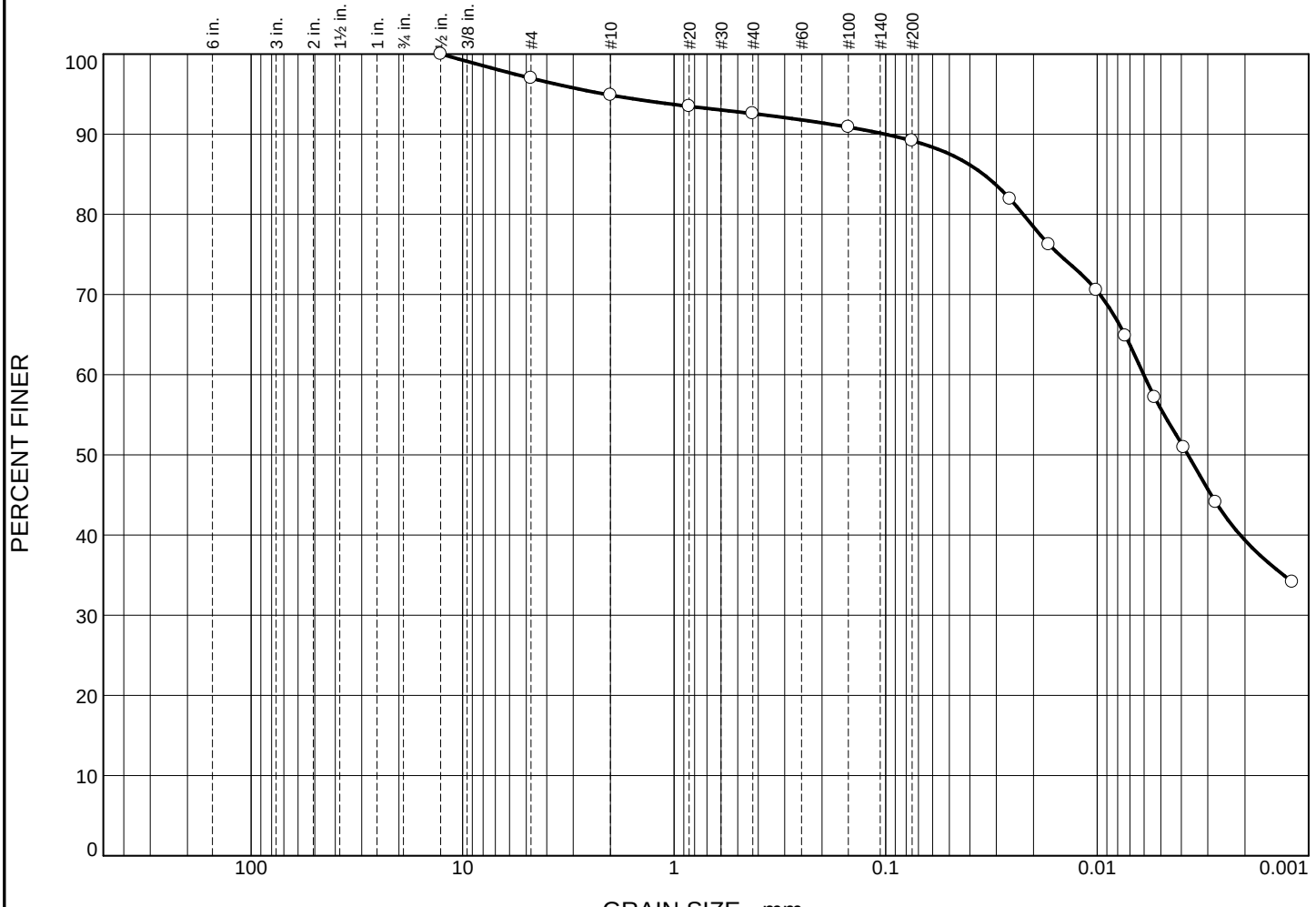
○N.W.C.= 4.7%

BAG SAMPLE

GEO-MECHANICS, INC.

Figure B-9

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	3.0	2.1	2.3	3.4	33.5	55.7

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	49	22	0.0345	0.0060	0.0037					

Material Description	USCS	AASHTO
○ Highly Plastic Silty Clay, Trace Sand, Trace Gravel, Moist (Colluvial)	CL	A-7-6(26)

Project No. 21016 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

○ **Source of Sample:** TB-17 **Depth:** 0.0'-4.5'

Remarks:

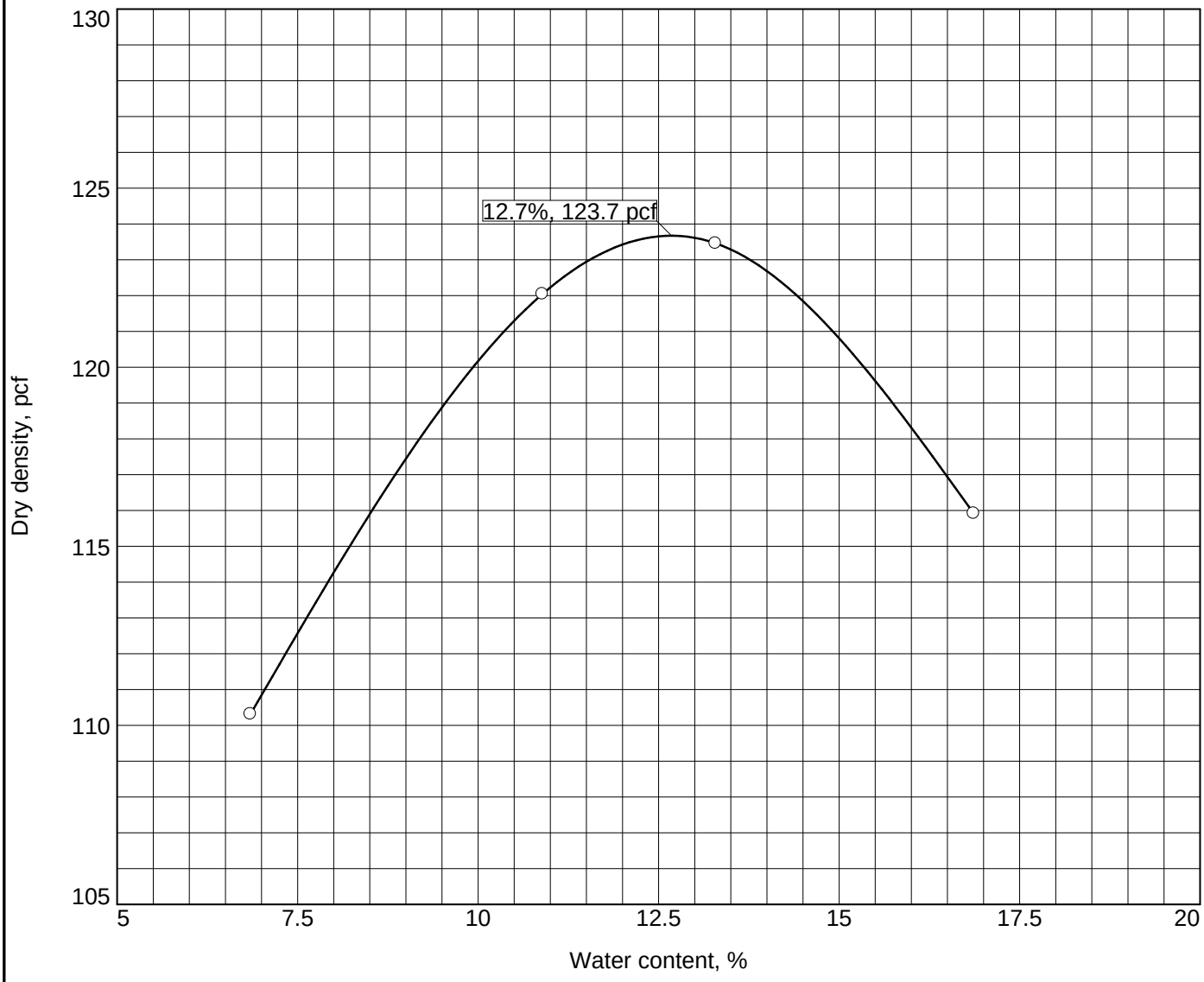
○N.W.C.= 21.3%

JAR SAMPLES

GEO-MECHANICS, INC.

Figure B-10

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
3.0'-12.0'	CL	A-6(12)	7.3		34	17	0.0	79.4

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 123.7 pcf Optimum moisture = 12.7 %	Moderately Plastic Silty Clay, Little Sand, Trace Gravel, Damp (Residual)

Project No. 21016 **Client:** KGA PARTNERS, LLC
Project: MEADOWS LANDING

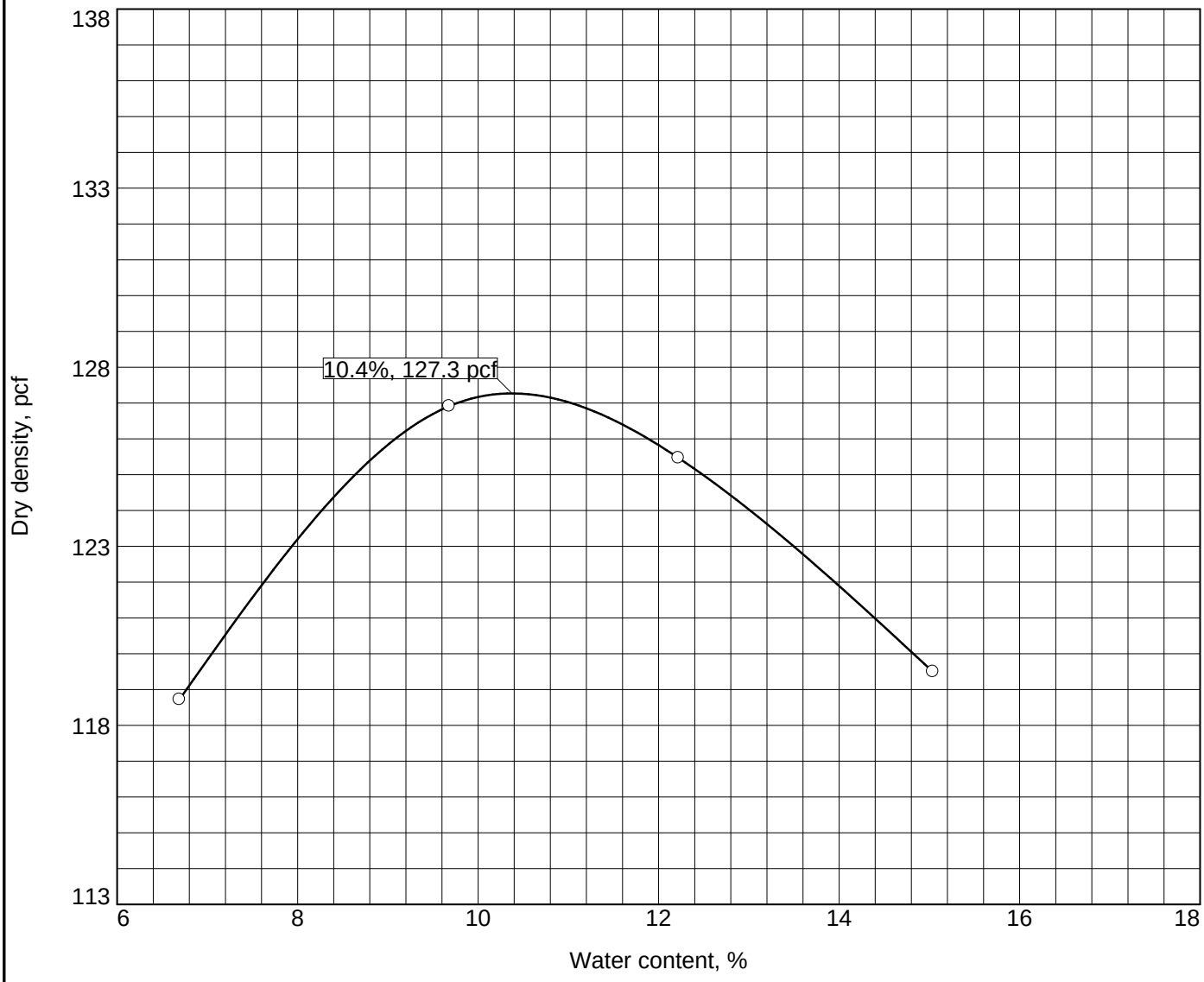
○**Source of Sample:** TB-5

Remarks:

GEO-MECHANICS, INC.

Figure B-11

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
3.0'-18.0'	CL	A-6(9)	4.7		34	16	0.0	70.2

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 127.3 pcf Optimum moisture = 10.4 %	Moderately Plastic Silty Clay, Some Sand, Trace Gravel, Dry (Residual)

Project No. 21016 **Client:** KGA PARTNERS, LLC
Project: MEADOWS LANDING

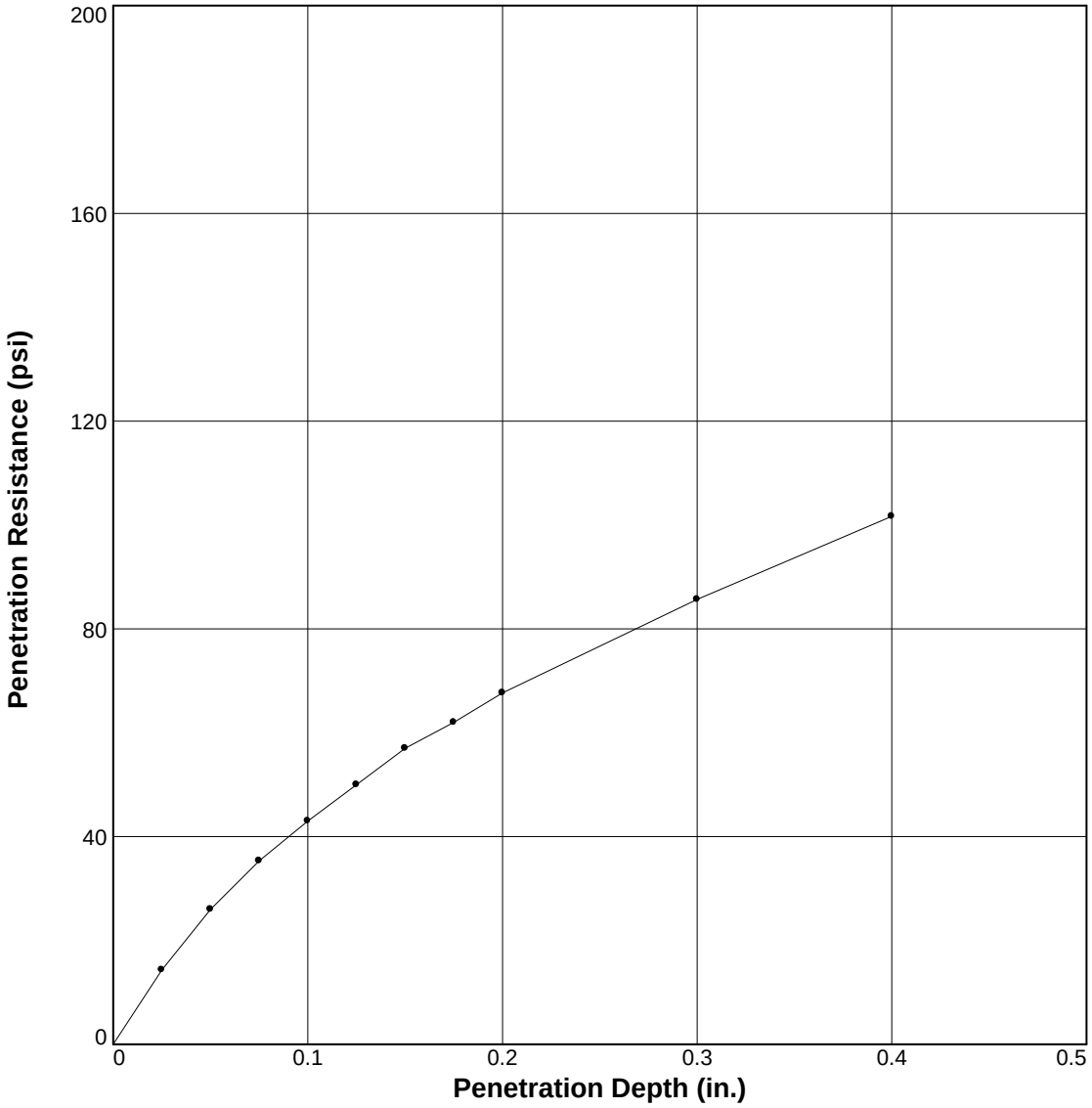
○**Source of Sample:** TB-15

Remarks:

GEO-MECHANICS, INC.

Figure B-12

BEARING RATIO TEST REPORT
ASTM D1883-16



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	117.8	95.2	12.9	116.1	93.9	15.4	4.3	4.5	0.000	30	1.5
2 △											
3 □											

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Moderately Plastic Silty Clay, Little Sand, Trace Gravel, Damp (Residual)	CL	123.7	12.7	34	17

Project No: 21016

Project: MEADOWS LANDING

Source of Sample: TB-5 **Depth:** 3.0'-12.0'

Date:

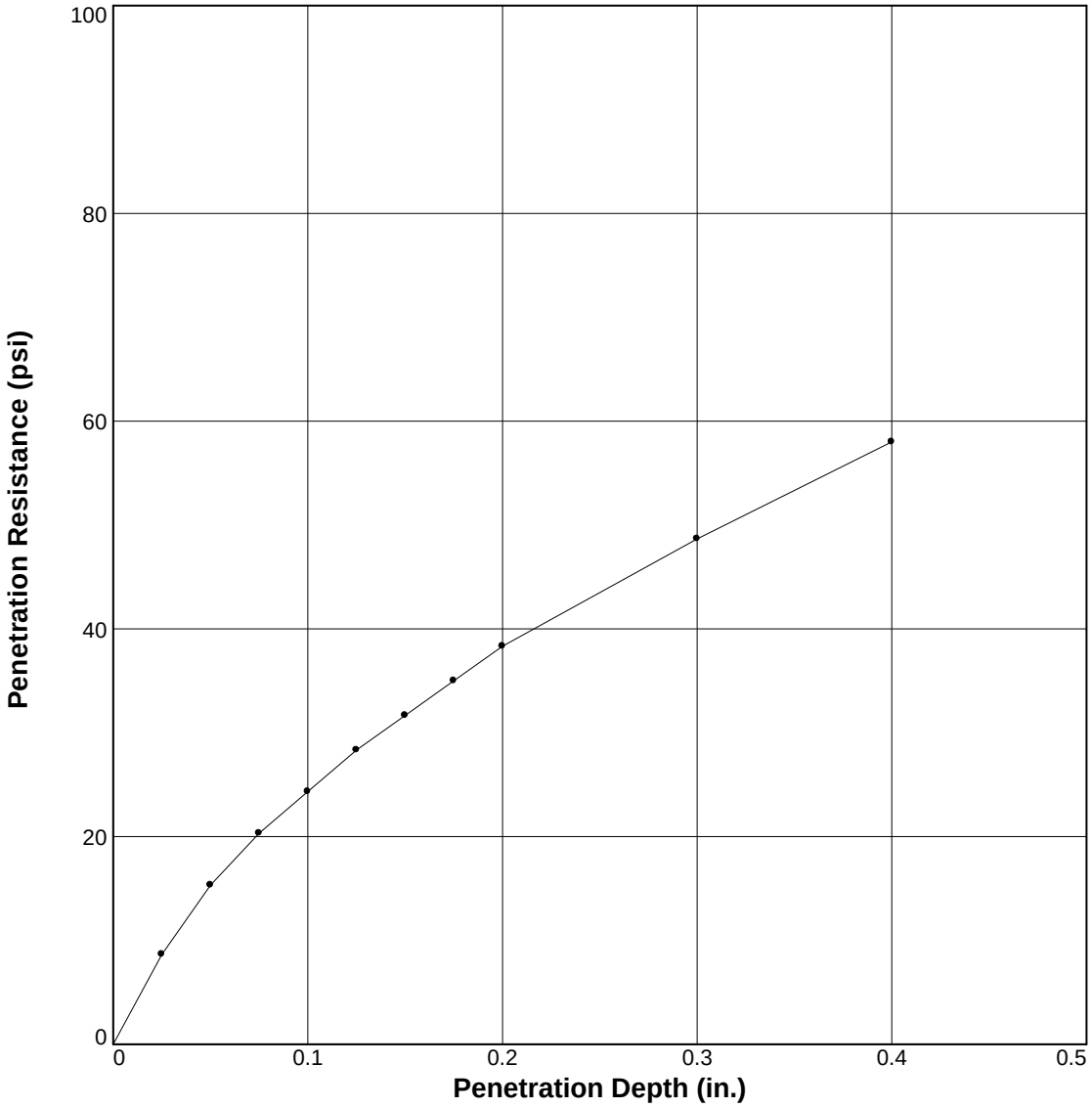
Test Description/Remarks:

BEARING RATIO TEST REPORT

GEO-MECHANICS, INC.

Figure B-13

BEARING RATIO TEST REPORT
ASTM D1883-16



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	120.6	94.7	10.2	119.3	93.7	16.4	2.4	2.6	0.000	30	1.2
2 △											
3 □											

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Moderately Plastic Silty Clay, Some Sand, Trace Gravel, Dry (Residual)	CL	127.3	10.4	34	16

Project No: 21016

Project: MEADOWS LANDING

Source of Sample: TB-15 **Depth:** 3.0'-18.0'

Date:

Test Description/Remarks:

BEARING RATIO TEST REPORT

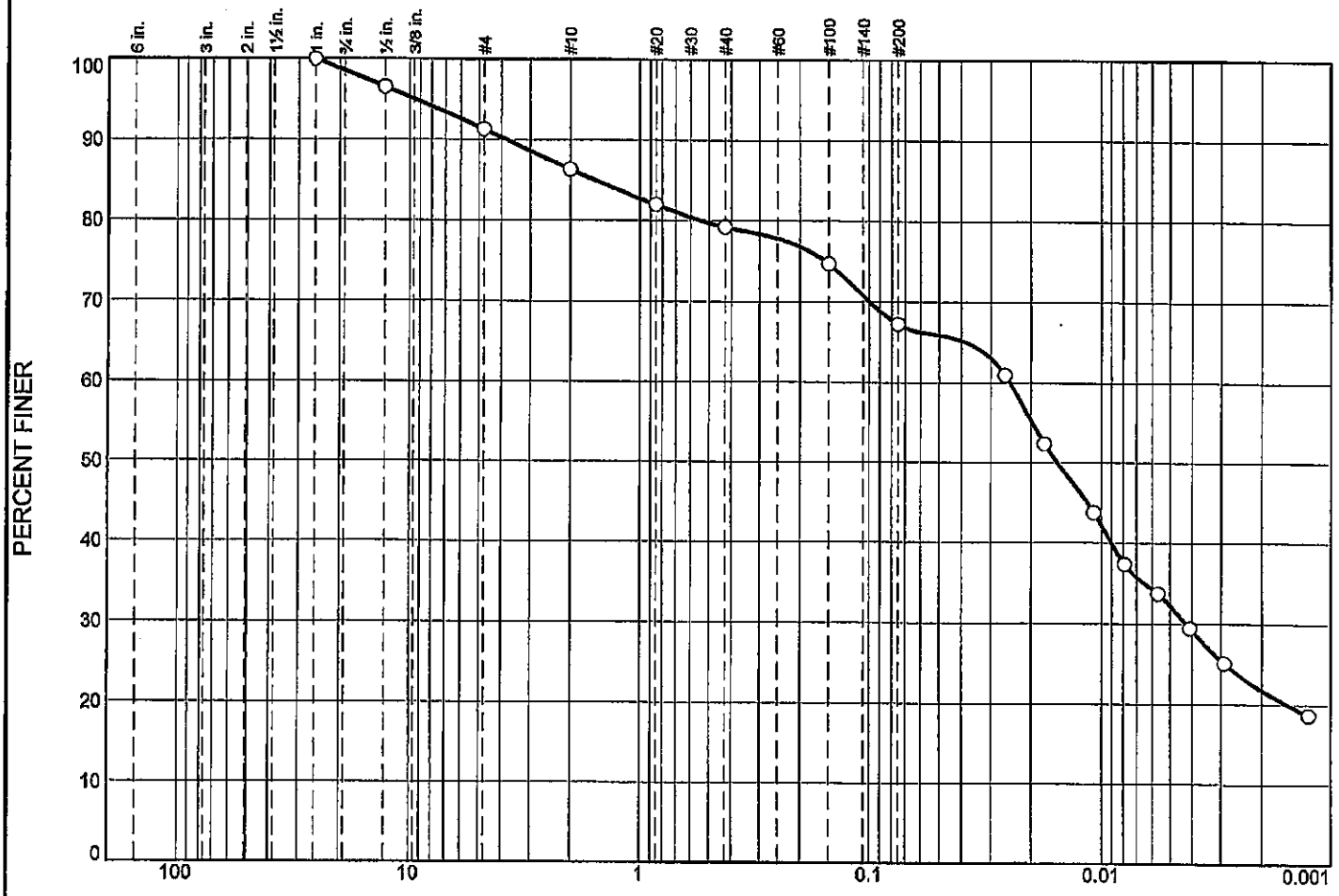
GEO-MECHANICS, INC.

Figure B-14

APPENDIX B-1:

Relevant GeoMechanics, Inc. Laboratory Test Results
2012 Investigation

Grain Size Distribution Test Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	1.4	7.3	5.0	7.1	11.9	35.1	32.2

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	31	17	1.5581	0.0247	0.0154	0.0043				

Material Description	USCS	AASHTO
○ Brown-Gray Silty Clay, Some Sand, Trace Gravel(Rock Fragments) RESIDUAL	CL	A-6(7)

Project No. 12022 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

SOUTH STRABANE TWP., WASHINGTON CO., PA

○ **Source of Sample:** GB-5 **Depth:** 0.0'-15.1'

Remarks:

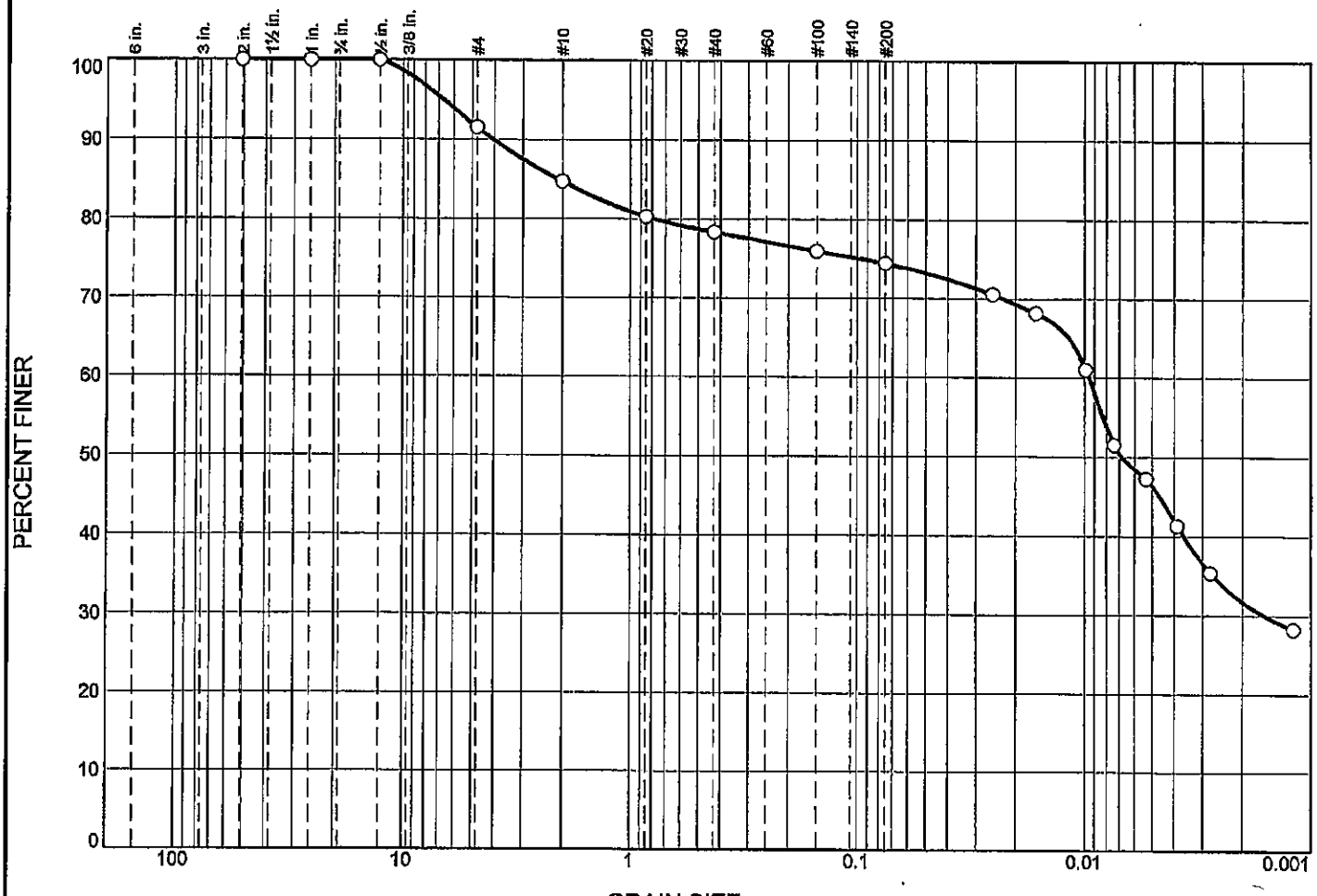
○N.W.C.= 9.4%

JAR SAMPLES

GEO-MECHANICS, INC.

Figure B-3

Grain Size Distribution Test Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	8.5	6.8	6.3	4.0	28.0	46.4

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	44	20	2.0959	0.0095	0.0068	0.0016				

Material Description	USCS	AASHTO
○ Brown Silty Clay, Little Sand, Trace Gravel(Rock Fragments) COLLUVIAL	CL	A-7-6(17)

Project No. 12022 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

SOUTH STRABANE TWP., WASHINGTON CO., PA

○ **Source of Sample:** GB-18 **Depth:** 3.0'-7.5'

Remarks:

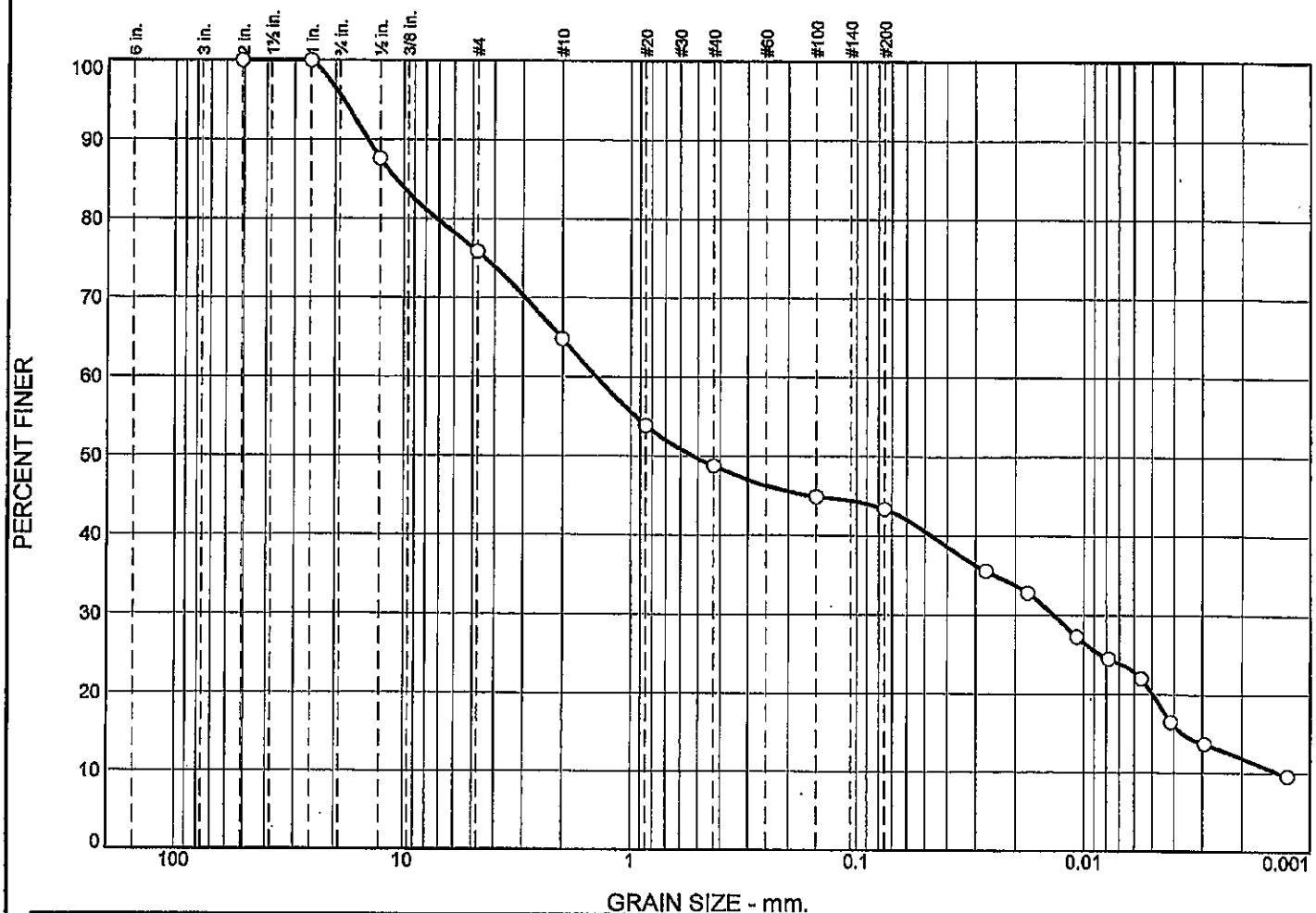
○N.W.C.= 15.8%

JAR SAMPLE

GEO-MECHANICS, INC.

Figure B-9

Grain Size Distribution Test Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	4.4	19.8	11.0	16.0	5.4	23.3	20.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	38	21	10.8416	1.4163	0.5231	0.0136	0.0037	0.0014	0.09	1032.01

Material Description	USCS	AASHTO
○ Gray-Brown Clayey Sand, Some Silt, Some Gravel(Rock Fragments) (Decomposed Sandy Shale)	SC	A-6(3)

Project No. 12022 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

SOUTH STRABANE TWP., WASHINGTON CO., PA

○ **Source of Sample:** GB-20 **Depth:** 9.0'-12.7'

Remarks:

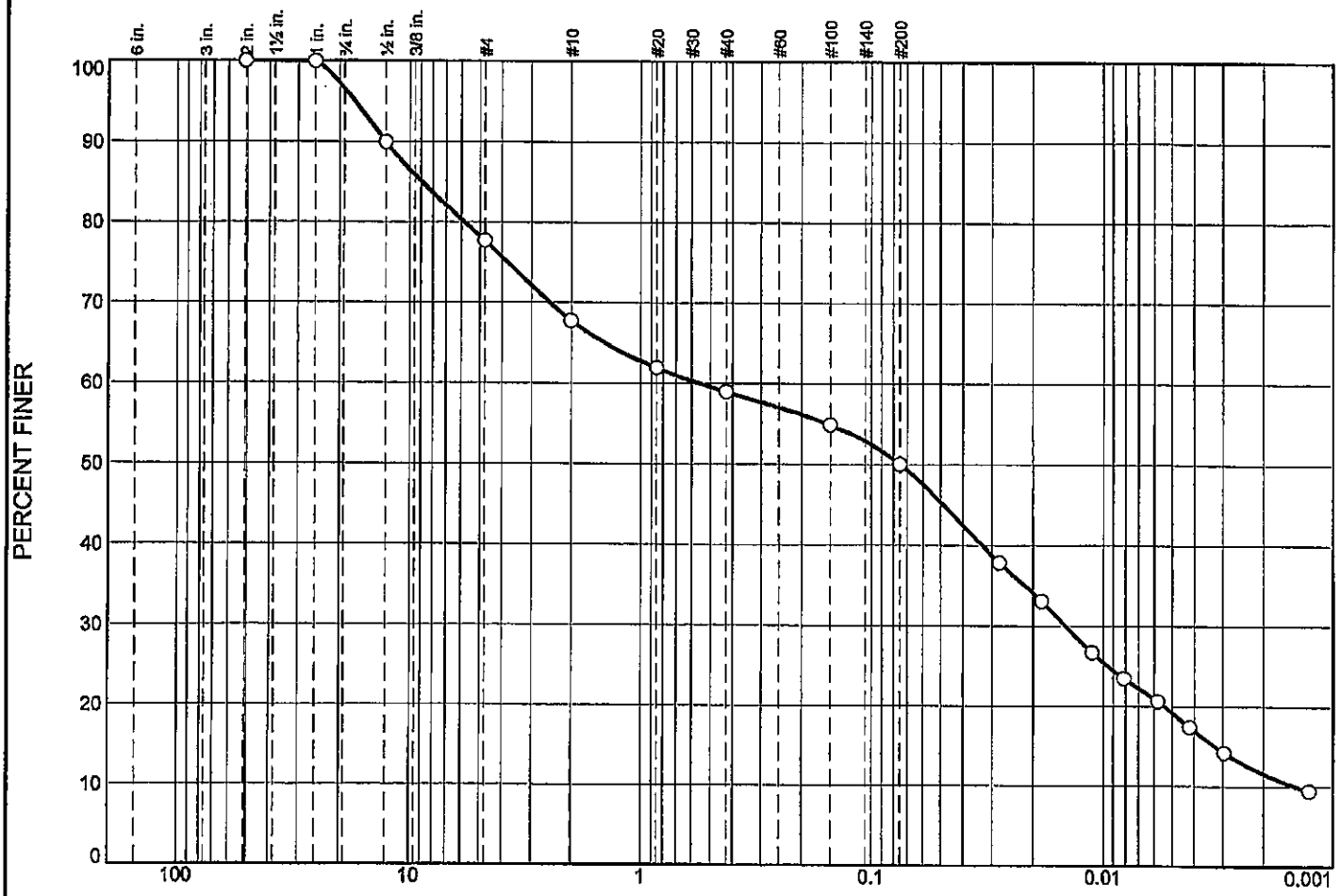
○N.W.C.= 8.4%

JAR SAMPLE

GEO-MECHANICS, INC.

Figure B-10

Grain Size Distribution Test Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	3.5	18.8	10.0	8.7	8.9	30.9	19.2

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	31	18	8.9532	0.5559	0.0746	0.0145	0.0032	0.0014	0.26	385.06

Material Description	USCS	AASHTO
○ Brown-Gray Silty Clay, Some Sand, Some Gravel(Rock Fragments) COLLUVIAL	CL	A-6(3)

Project No. 12022 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

SOUTH STRABANE TWP., WASHINGTON CO., PA

○ **Source of Sample:** GB-22 **Depth:** 9.0'-13.5'

Remarks:

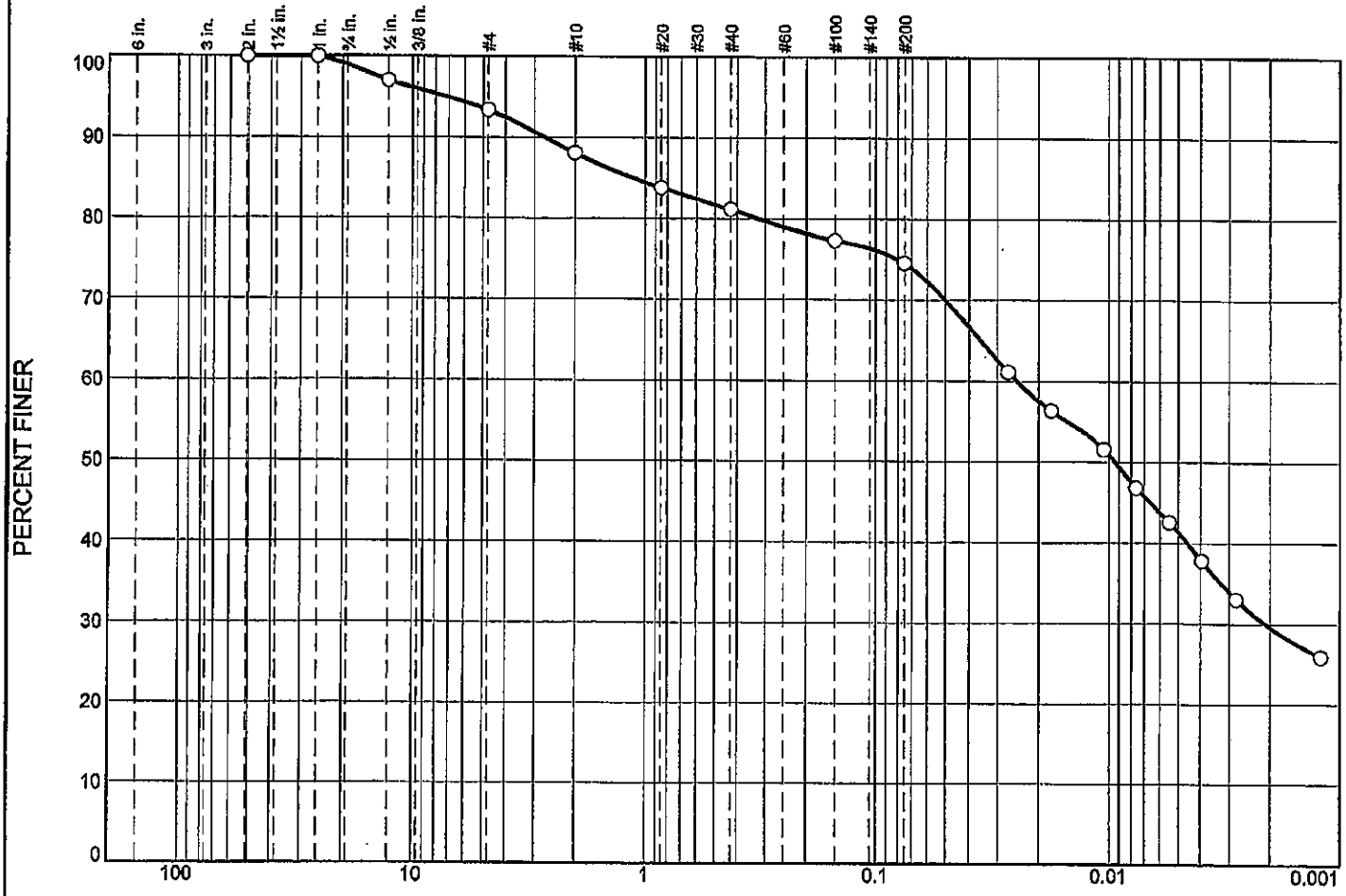
○N.W.C.= 13.9%

JAR SAMPLE

GEO-MECHANICS, INC.

Figure B-11

Grain Size Distribution Test Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	1.0	5.6	5.3	7.0	6.6	33.1	41.4

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	49	25	1.1259	0.0248	0.0094	0.0021				

Material Description	USCS	AASHTO
○ Brown Silty Clay, Little Sand, Trace Gravel(Rock Fragments) COLLUVIAL	CL	A-7-6(18)

Project No. 12022 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

SOUTH STRABANE TWP., WASHINGTON CO., PA

○ **Source of Sample:** GB-23 **Depth:** 3.0'-7.5'

Remarks:

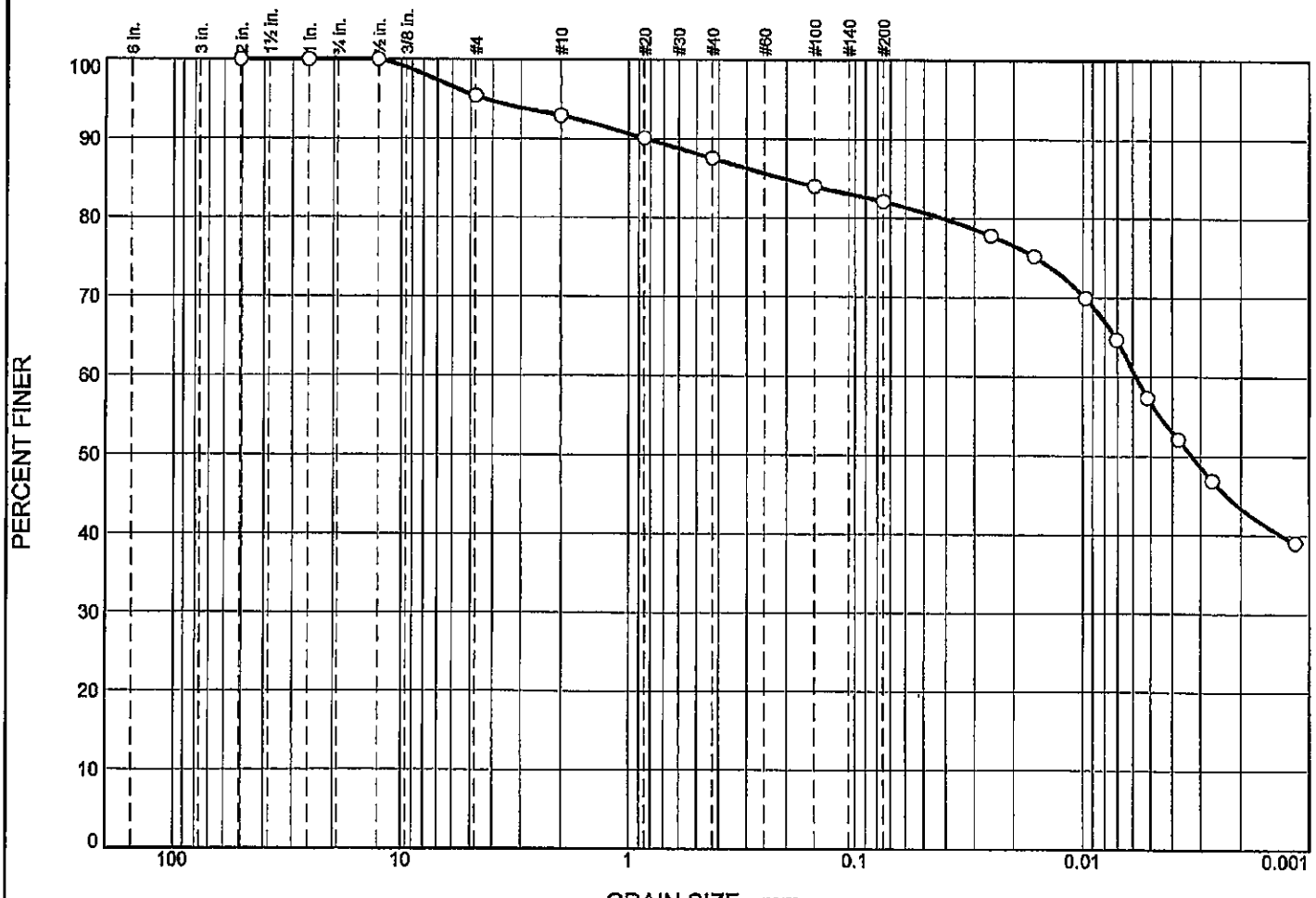
○N.W.C.= 22.5%

JAR SAMPLE

GEO-MECHANICS, INC.

Figure B-12

Grain Size Distribution Test Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
o	0.0	0.0	4.6	2.5	5.3	5.5	25.4	56.7

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
o	38	19	0.2060	0.0058	0.0033					

Material Description	USCS	AASHTO
o Brown Silty Clay, Little Sand, Trace Gravel(Rock Fragments) COLLUVIAL	CL	A-6(15)

Project No. 12022 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

SOUTH STRABANE TWP., WASHINGTON CO., PA

o **Source of Sample:** GB-24 **Depth:** 9.0'-10.5

Remarks:

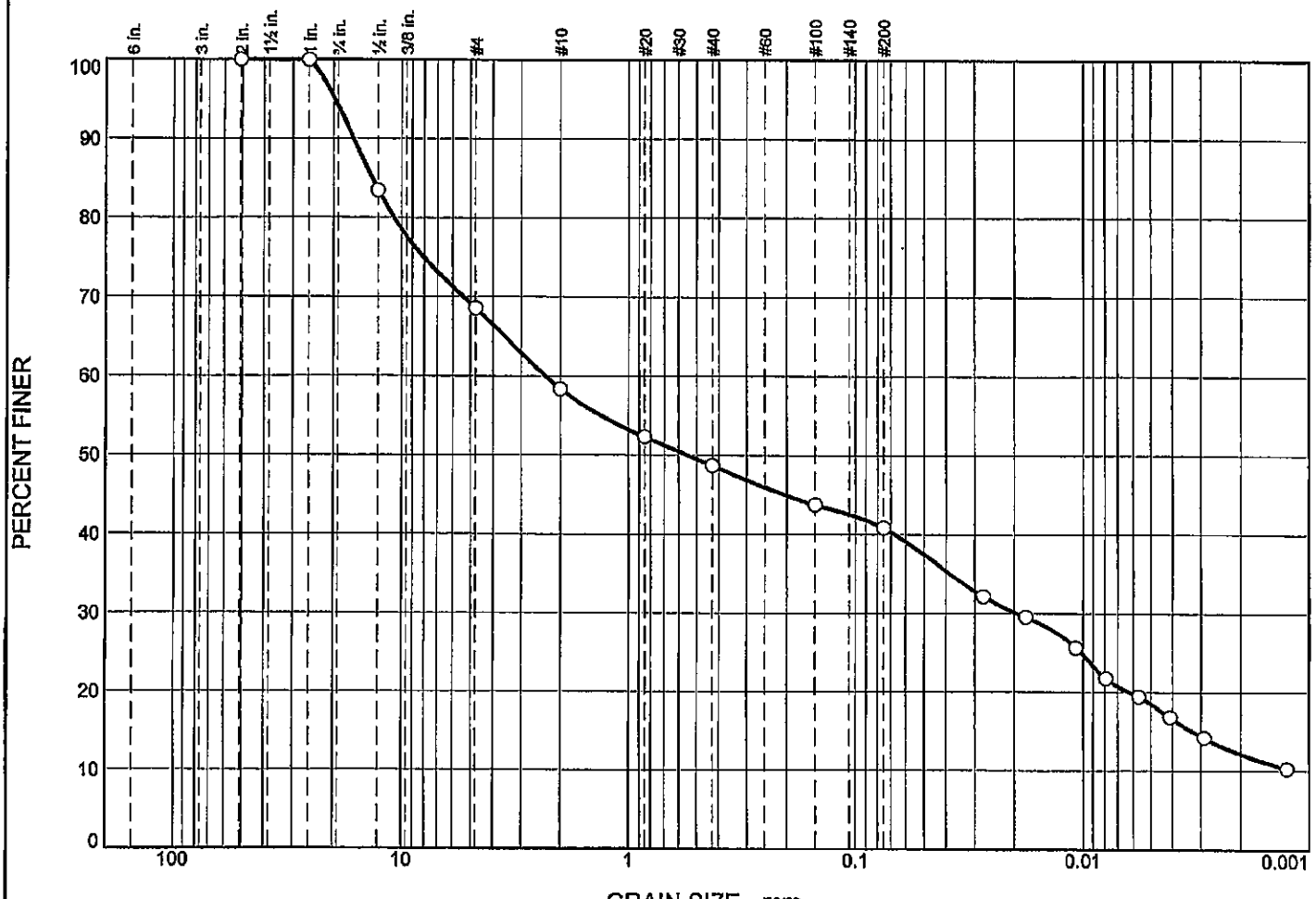
oN.W.C.= 12.6%

SHELBY TUBE

GEO-MECHANICS, INC.

Figure B-13

Grain Size Distribution Test Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	5.9	25.5	10.3	9.6	7.9	22.3	18.5

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○	37	21	13.5471	2.3431	0.5492	0.0194	0.0033			

Material Description	USCS	AASHTO
○ Gray Clayey Gravel, Some Sand, Some Silt (Decomposed Siltstone)	GC	A-6(3)

Project No. 12022 **Client:** KGA PARTNERS, LLC

Project: MEADOWS LANDING

SOUTH STRABANE TWP., WASHINGTON CO., PA

○ **Source of Sample:** GB-25 **Depth:** 12.0'-16.5'

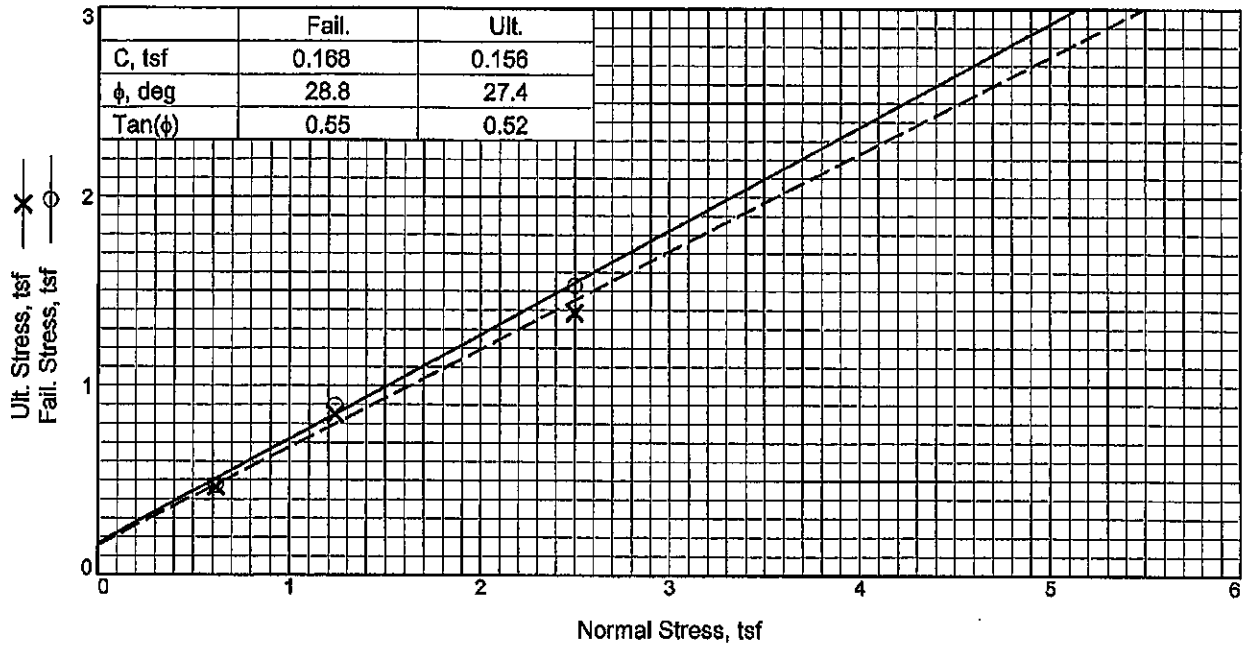
Remarks:

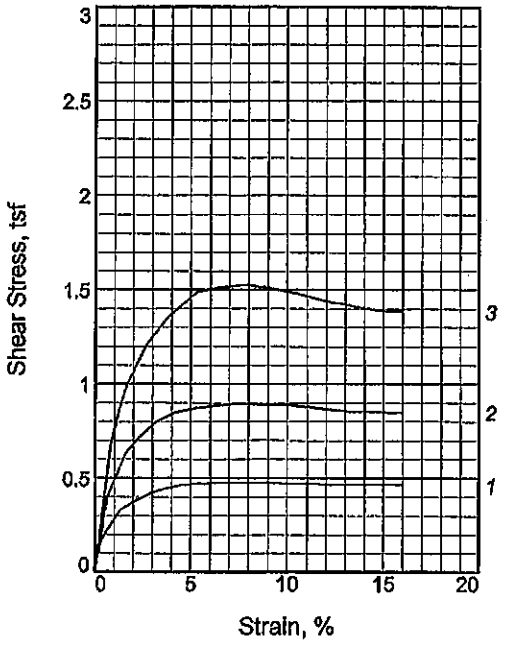
○N.W.C.= 16.3%

JAR SAMPLE

GEO-MECHANICS, INC.

Figure B-14





Sample No.		1	2	3
Initial	Water Content, %	10.3	11.4	11.3
	Dry Density, pcf	110.8	110.0	111.4
	Saturation, %	54.4	58.4	60.6
	Void Ratio	0.5094	0.5216	0.5016
	Diameter, in.	2.500	2.500	2.500
	Height, in.	0.776	0.777	0.777
At Test	Water Content, %	18.8	18.8	17.4
	Dry Density, pcf	111.0	110.9	113.8
	Saturation, %	99.3	98.9	99.2
	Void Ratio	0.5071	0.5090	0.4707
	Diameter, in.	2.500	2.500	2.500
	Height, in.	0.775	0.771	0.761
Normal Stress, tsf		0.617	1.235	2.499
Fail. Stress, tsf		0.475	0.897	1.529
Strain, %		6.8	7.3	7.8
Ult. Stress, tsf		0.463	0.849	1.384
Strain, %		16.0	16.0	16.0
Strain rate, in./min.		0.001	0.001	0.001

Sample Type: REMOLDED
Description: Brown-Gray Silty Clay, Some Sand, Trace Gravel(Rock Fragments) RESIDUAL
LL= 31 **PL=** 17 **PI=** 14
Specific Gravity= 2.68
Remarks:

Client: KGA PARTNERS, LLC

Project: MEADOWS LANDING
SOUTH STRABANE TWP., WASHINGTON CO., PA
Source of Sample: GB-5 **Depth:** 0.0'-15.1'

Proj. No.: 12022 **Date Sampled:**

DIRECT SHEAR TEST REPORT

GEO-MECHANICS, INC.

Figure B-15

APPENDIX C
Test Boring Location Plan, Geologic Cross-Sections and Roadway Profiles

AREA 1

AREA 2

AREA 3

AREA 4

AREA 5

AREA 6

LEGEND

P– INFILTRATION BORING

GB– PREVIOUSLY DRILLED BORING (GMI PROJECT NO. 12022)

B– PREVIOUSLY DRILLED BORING (ACA 2011)

B– PREVIOUSLY DRILLED BORING (ACA 2006)

TB– PREVIOUSLY DRILLED BORING (GMI PROJECT NO. 08068)

TB– PROPOSED BORINGS (2021)

TEST BORING LOCATION PLAN

0 120 240

SCALE IN FEET

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TOWNSHIP, WASHINGTON COUNTY, PA

TEST BORING LOCATION PLAN

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	1 of 24

GeoMechanics, inc
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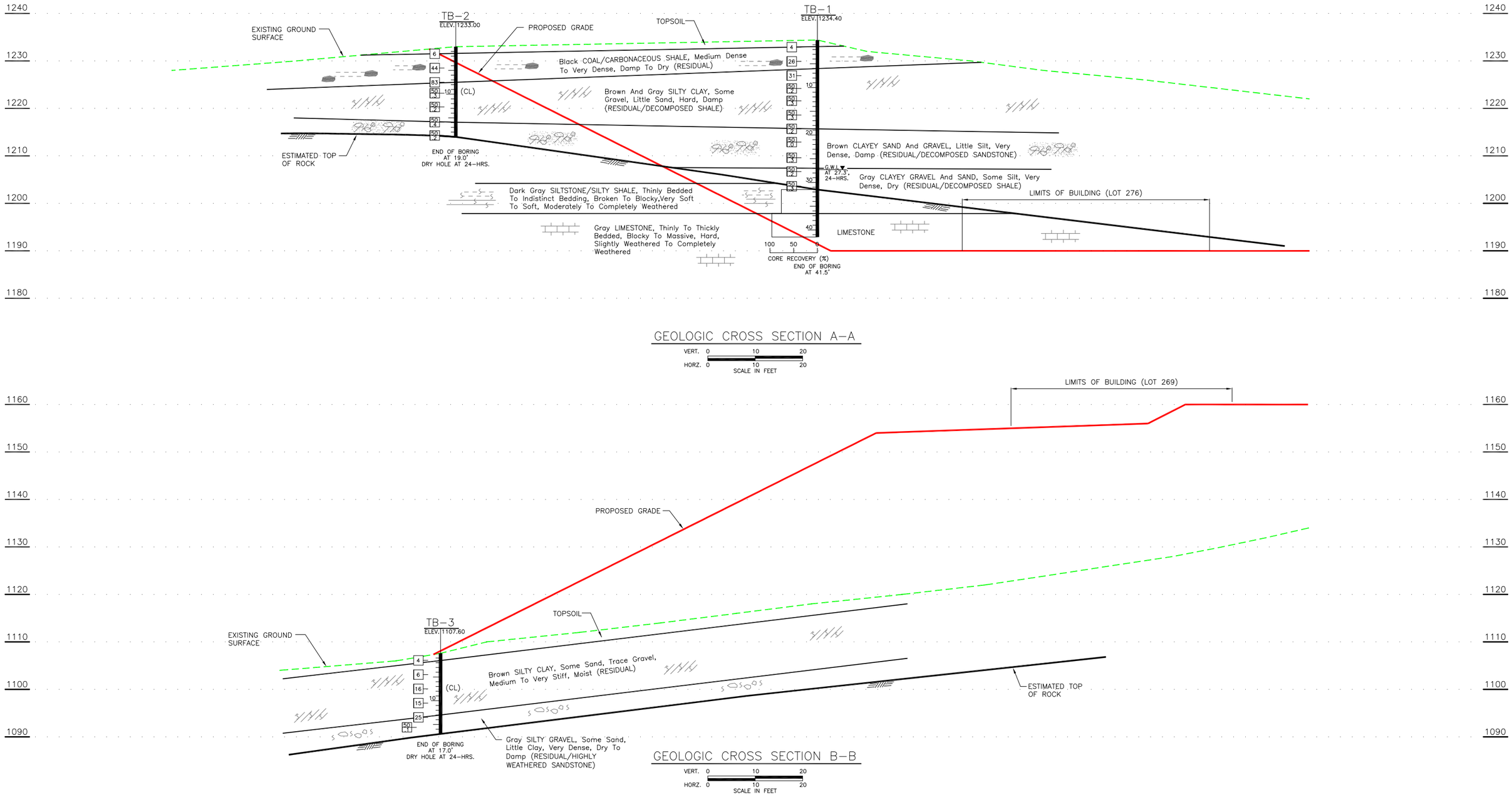
gmi@geo-mechanics.com



GEOLOGIC CROSS SECTION A-A

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

GEOLOGIC CROSS SECTION B-B

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
- LIMESTONE
- SANDSTONE
- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24-HRS. — GROUND WATER LEVEL
- (CL) — USCS CLASSIFICATION FROM TEST DATA

TERMINOLOGY FOR SOIL DESCRIPTION

CONSISTENCY OF COHESIVE SOILS		
CONSISTENCY	BLOWS/FOOT	UNCONFINED COMPRESSIVE STRENGTH, T.S.F.
V. SOFT	0 – 2	< 0.25
SOFT	3 – 4	0.25 TO 0.50
MED. STIFF	5 – 8	0.50 TO 1.0
STIFF	9 – 16	1.0 TO 1.5
V. STIFF	17 – 32	1.5 TO 2.0
HARD	> 32	> 2.0

DENSITY OF GRANULAR SOILS	
DESIGNATION	BLOWS PER FOOT
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
VERY DENSE	OVER 50

STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2-INCH O.D. SPLIT SPOON SAMPLER INTO THE SOILS USING A 140-POUND HAMMER FALLING FREELY THROUGH 30 INCHES. THE SAMPLER IS DRIVEN 18 INCHES, AND THE COMBINED NUMBER OF BLOWS FOR THE LAST TWO 6-INCH INTERVALS IS DESIGNATED AS STANDARD PENETRATION RESISTANCE (SPT N-VALUES).

THE DEPTH AND THICKNESS OF THE SOIL AND ROCK STRATA INDICATED ON THESE GEOLOGIC CROSS SECTIONS ARE GENERALIZED FROM AND INTERPOLATED BETWEEN THE TEST BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS. IT IS POSSIBLE THAT SUBSURFACE CONDITIONS BETWEEN THE TEST BORINGS MAY VARY FROM THOSE SHOWN.

TERMINOLOGY FOR ROCK DESCRIPTION

DESCRIPTIVE TERMS	DEFINING CHARACTERISTICS OF HARDNESS OF ROCK CORES
VERY SOFT	CRUSHES UNDER PRESSURE OF FINGERS AND/OR THUMB
SOFT	CRUSHES UNDER PRESSURE OF PRESSED HAMMER
MEDIUM HARD	BREAKS EASILY UNDER SINGLE HAMMER BLOW BUT WITH CRUMBLY EDGES
HARD	BREAKS UNDER ONE OR TWO STRONG HAMMER BLOWS BUT WITH RESISTANT SHARP EDGES
VERY HARD	BREAKS UNDER SEVERAL STRONG HAMMER BLOWS BUT WITH VERY RESISTANT SHARP EDGES AND MAY SPALL LEAVING CONCHOIDAL FRACTURES

SPACING OF DISCONTINUITIES		
DESCRIPTIVE TERMS	SPACING	
V. BROKEN	< 3 cm.	(<1")
BROKEN	3cm.-8cm.	(1"-3")
BLOCKY	8cm.-15cm.	(3"-6")
MASSIVE	> 15 cm.	(>6")

THICKNESS OF BEDDING		
DESCRIPTIVE TERMS	THICKNESS	
THINLY LAMINATED	< 0.3cm.	<1/8"
THICKLY LAMINATED	0.3 – 1cm.	1/8-1/2"
V. THINLY BEDDED	1 – 3cm.	1/2-1"
THINLY BEDDED	3 – 10cm.	1-4"
MEDIUM BEDDED	10 -30cm.	4-12"
THICKLY BEDDED	30 – 100cm.	12-40"
V. THICKLY BEDDED	> 1m.	>40"

TERMS USED TO DESCRIBE WEATHERING OF DISCONTINUITIES	
TERM	DESCRIPTION
FRESH OR UNWEATHERED	NO VISIBLE SIGN OF ROCK MATERIAL WEATHERING. PERHAPS SLIGHT DISCOLORATION ON MAJOR DISCONTINUITY SURFACES.
SLIGHTLY WEATHERED	DISCOLORATION INDICATES WEATHERING OF ROCK MATERIAL AND DISCONTINUITY SURFACES. ALL THE ROCK MATERIAL MAY BE DISCOLORED BY WEATHERING AND MAY BE SOMEWHAT WEAKER EXTERNALLY THAN IN ITS FRESH CONDITION.
HIGHLY WEATHERED	MORE THAN HALF OF THE ROCK MATERIAL IS DECOMPOSED AND/OR DISINTEGRATED TO A SOIL. FRESH OR DISCOLORED ROCK IS PRESENT EITHER AS A DISCONTINUOUS FRAMEWORK OR AS ROCK FRAGMENTS OR CORESTONES.
COMPLETELY WEATHERED	ALL ROCK MATERIAL IS DECOMPOSED AND/OR DISINTEGRATED TO SOIL. THE ORIGINAL MASS STRUCTURE IS STILL LARGELY INTACT.
RESIDUAL SOIL	ALL ROCK MATERIAL IS CONVERTED TO SOIL. THE MASS STRUCTURE AND MATERIAL FABRIC ARE DESTROYED. THERE IS A LARGE CHANGE IN VOLUME, BUT THE SOIL HAS NOT BEEN SIGNIFICANTLY TRANSPORTED.

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTIONS A-A AND B-B

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	2 of 24

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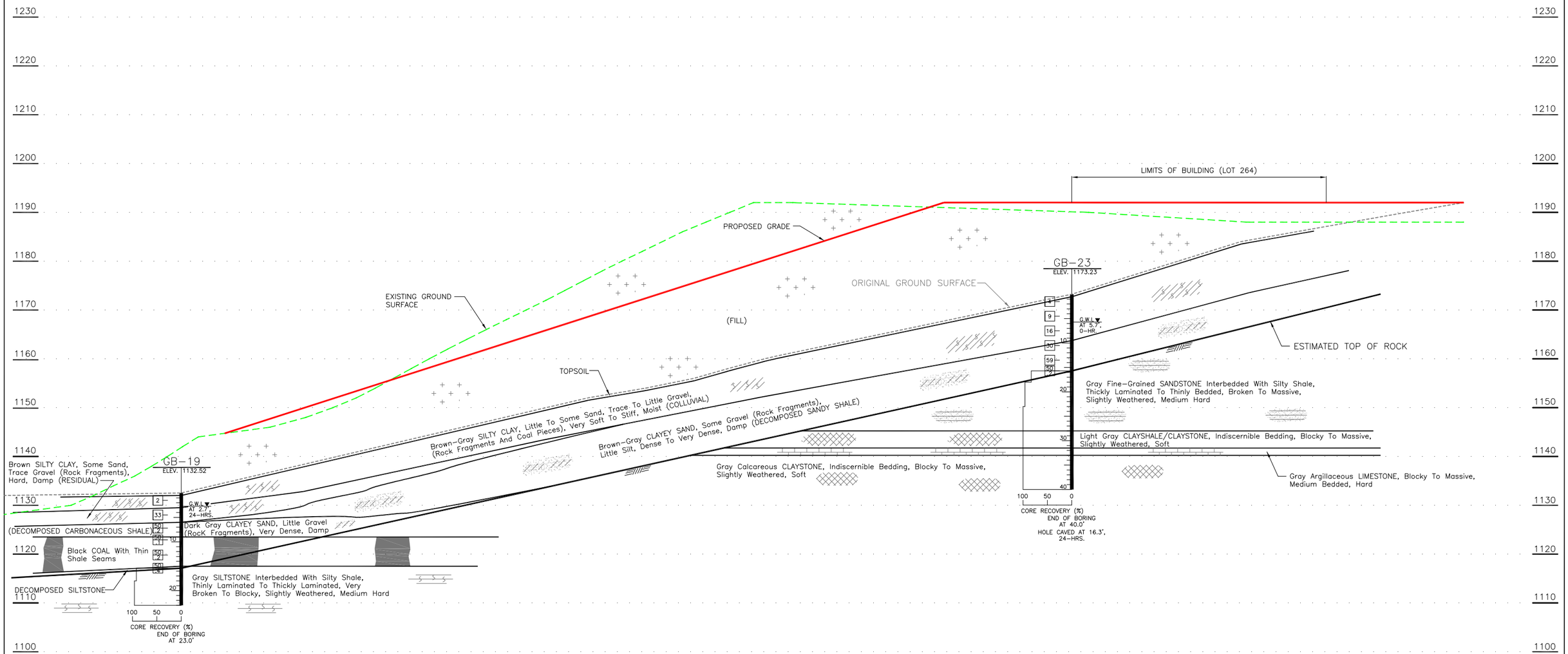

GEOLOGIC CROSS SECTION C-C

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
- LIMESTONE
- SANDSTONE
- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24-HRS. — GROUND WATER LEVEL
- (CL) — USCS CLASSIFICATION FROM TEST DATA

TERMINOLOGY FOR SOIL DESCRIPTION

CONSISTENCY OF COHESIVE SOILS		
CONSISTENCY	BLOWS/FOOT	UNCONFINED COMPRESSIVE STRENGTH, T.S.F.
V. SOFT	0 - 2	< 0.25
SOFT	3 - 4	0.25 TO 0.50
MED. STIFF	5 - 8	0.50 TO 1.0
STIFF	9 - 16	1.0 TO 1.5
V. STIFF	17 - 32	1.5 TO 2.0
HARD	> 32	> 2.0

DENSITY OF GRANULAR SOILS	
DESIGNATION	BLOWS PER FOOT
VERY LOOSE	0 - 4
LOOSE	5 - 10
MEDIUM DENSE	11 - 30
DENSE	31 - 50
VERY DENSE	OVER 50

STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2-INCH O.D. SPLIT SPOON SAMPLER INTO THE SOILS USING A 140-POUND HAMMER FALLING FREELY THROUGH 30 INCHES. THE SAMPLER IS DRIVEN 18 INCHES, AND THE COMBINED NUMBER OF BLOWS FOR THE LAST TWO 6-INCH INTERVALS IS DESIGNATED AS STANDARD PENETRATION RESISTANCE (SPT N-VALUES).

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TERMINOLOGY FOR ROCK DESCRIPTION

DESCRIPTIVE TERMS	DEFINING CHARACTERISTICS OF HARDNESS OF ROCK CORES
VERY SOFT	CRUSHES UNDER PRESSURE OF FINGERS AND/OR THUMB
SOFT	CRUSHES UNDER PRESSURE OF PRESSED HAMMER
MEDIUM HARD	BREAKS EASILY UNDER SINGLE HAMMER BLOW BUT WITH CRUMBLY EDGES
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SPACING OF DISCONTINUITIES		
DESCRIPTIVE TERMS	SPACING	
V. BROKEN	< 3 cm.	(<1")
BROKEN	3cm.-8cm.	(1"-3")
BLOCKY	8cm.-15cm.	(3"-6")
MASSIVE	> 15 cm.	(>6")

THICKNESS OF BEDDING		
DESCRIPTIVE TERMS	THICKNESS	
THINLY LAMINATED	< 0.3cm.	<1/8"
THICKLY LAMINATED	0.3 - 1cm.	1/8-1/2"
V. THINLY BEDDED	1 - 3cm.	1/2-1"
THINLY BEDDED	3 - 10cm.	1-4"
MEDIUM BEDDED	10 -30cm.	4-12"
THICKLY BEDDED	30 - 100cm.	12-40"
V. THICKLY BEDDED	> 1m.	>40"

TERMS USED TO DESCRIBE WEATHERING OF DISCONTINUITIES	
TERM	DESCRIPTION
FRESH OR UNWEATHERED	NO VISIBLE SIGN OF ROCK MATERIAL WEATHERING. PERHAPS SLIGHT DISCOLORATION ON MAJOR DISCONTINUITY SURFACES.
SLIGHTLY WEATHERED	DISCOLORATION INDICATES WEATHERING OF ROCK MATERIAL AND DISCONTINUITY SURFACES. ALL THE ROCK MATERIAL MAY BE DISCOLORED BY WEATHERING AND MAY BE SOMEWHAT WEAKER EXTERNALLY THAN IN ITS FRESH CONDITION.
HIGHLY WEATHERED	MORE THAN HALF OF THE ROCK MATERIAL IS DECOMPOSED AND/OR DISINTEGRATED TO A SOIL. FRESH OR DISCOLORED ROCK IS PRESENT EITHER AS A DISCONTINUOUS FRAMEWORK OR AS ROCK FRAGMENTS OR CORESTONES.
COMPLETELY WEATHERED	ALL ROCK MATERIAL IS DECOMPOSED AND/OR DISINTEGRATED TO SOIL. THE ORIGINAL MASS STRUCTURE IS STILL LARGELY INTACT.
RESIDUAL SOIL	ALL ROCK MATERIAL IS CONVERTED TO SOIL. THE MASS STRUCTURE AND MATERIAL FABRIC ARE DESTROYED. THERE IS A LARGE CHANGE IN VOLUME, BUT THE SOIL HAS NOT BEEN SIGNIFICANTLY TRANSPORTED.

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTION C-C

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	3 of 24

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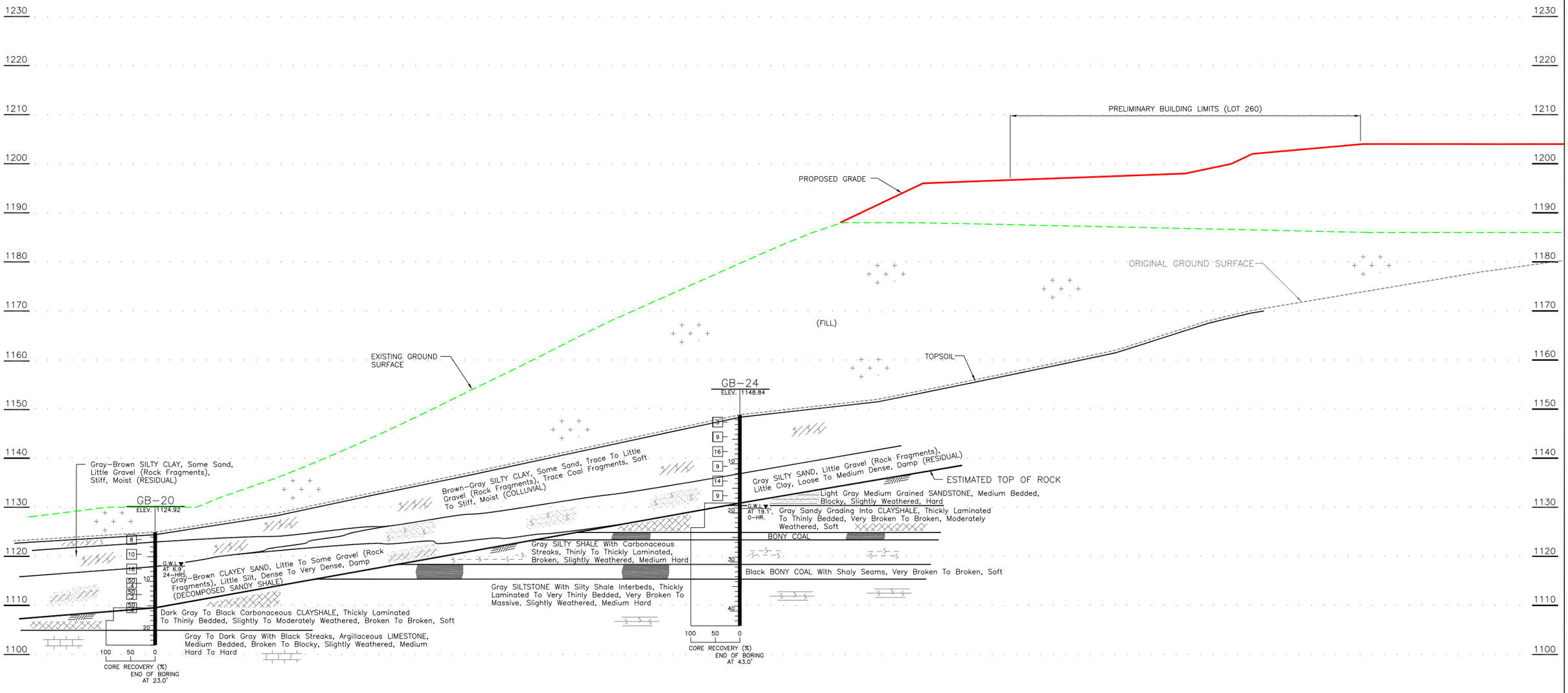

GEOLOGIC CROSS SECTION D-D

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
- LIMESTONE
- SANDSTONE
- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24-HRS. — GROUND WATER LEVEL
- (CL) — USCS CLASSIFICATION FROM TEST DATA

TERMINOLOGY FOR SOIL DESCRIPTION

CONSISTENCY OF COHESIVE SOILS		
CONSISTENCY	BLOWS/FOOT	UNCONFINED COMPRESSIVE STRENGTH, T.S.F.
V. SOFT	0 – 2	< 0.25
SOFT	3 – 4	0.25 TO 0.50
MED. STIFF	5 – 8	0.50 TO 1.0
STIFF	9 – 16	1.0 TO 1.5
V. STIFF	17 – 32	1.5 TO 2.0
HARD	> 32	> 2.0

DENSITY OF GRANULAR SOILS	
DESIGNATION	BLOWS PER FOOT
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
VERY DENSE	OVER 50

STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2-INCH O.D. SPLIT SPOON SAMPLER INTO THE SOILS USING A 140-POUND HAMMER FALLING FREELY THROUGH 30 INCHES. THE SAMPLER IS DRIVEN 18 INCHES, AND THE COMBINED NUMBER OF BLOWS FOR THE LAST TWO 6-INCH INTERVALS IS DESIGNATED AS STANDARD PENETRATION RESISTANCE (SPT N-VALUES).

THE DEPTH AND THICKNESS OF THE SOIL AND ROCK STRATA INDICATED ON THESE GEOLOGIC CROSS SECTIONS ARE GENERALIZED FROM AND INTERPOLATED BETWEEN THE TEST BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS. IT IS POSSIBLE THAT SUBSURFACE CONDITIONS BETWEEN THE TEST BORINGS MAY VARY FROM THOSE SHOWN.

TERMINOLOGY FOR ROCK DESCRIPTION

DESCRIPTIVE TERMS	DEFINING CHARACTERISTICS OF HARDNESS OF ROCK CORES
VERY SOFT	CRUSHES UNDER PRESSURE OF FINGERS AND/OR THUMB
SOFT	CRUSHES UNDER PRESSURE OF PRESSED HAMMER
MEDIUM HARD	BREAKS EASILY UNDER SINGLE HAMMER BLOW BUT WITH CRUMBLY EDGES
HARD	BREAKS UNDER ONE OR TWO STRONG HAMMER BLOWS BUT WITH RESISTANT SHARP EDGES
VERY HARD	BREAKS UNDER SEVERAL STRONG HAMMER BLOWS BUT WITH VERY RESISTANT SHARP EDGES AND MAY SPALL LEAVING CONCHOIDAL FRACTURES

SPACING OF DISCONTINUITIES		
DESCRIPTIVE TERMS	SPACING	
V. BROKEN	< 3 cm.	(<1")
BROKEN	3cm.-8cm.	(1"-3")
BLOCKY	8cm.-15cm.	(3"-6")
MASSIVE	> 15 cm.	(>6")

THICKNESS OF BEDDING		
DESCRIPTIVE TERMS	THICKNESS	
THINLY LAMINATED	< 0.3cm.	<1/8"
THICKLY LAMINATED	0.3 – 1cm.	1/8-1/2"
V. THINLY BEDDED	1 – 3cm.	1/2-1"
THINLY BEDDED	3 – 10cm.	1-4"
MEDIUM BEDDED	10 -30cm.	4-12"
THICKLY BEDDED	30 – 100cm.	12-40"
V. THICKLY BEDDED	> 1m.	>40"

TERMS USED TO DESCRIBE WEATHERING OF DISCONTINUITIES	
TERM	DESCRIPTION
FRESH OR UNWEATHERED	NO VISIBLE SIGN OF ROCK MATERIAL WEATHERING. PERHAPS SLIGHT DISCOLORATION ON MAJOR DISCONTINUITY SURFACES.
SLIGHTLY WEATHERED	DISCOLORATION INDICATES WEATHERING OF ROCK MATERIAL AND DISCONTINUITY SURFACES. ALL THE ROCK MATERIAL MAY BE DISCOLORED BY WEATHERING AND MAY BE SOMEWHAT WEAKER EXTERNALLY THAN IN ITS FRESH CONDITION.
HIGHLY WEATHERED	MORE THAN HALF OF THE ROCK MATERIAL IS DECOMPOSED AND/OR DISINTEGRATED TO A SOIL. FRESH OR DISCOLORED ROCK IS PRESENT EITHER AS A DISCONTINUOUS FRAMEWORK OR AS ROCK FRAGMENTS OR CORESTONES.
COMPLETELY WEATHERED	ALL ROCK MATERIAL IS DECOMPOSED AND/OR DISINTEGRATED TO SOIL. THE ORIGINAL MASS STRUCTURE IS STILL LARGELY INTACT.
RESIDUAL SOIL	ALL ROCK MATERIAL IS CONVERTED TO SOIL. THE MASS STRUCTURE AND MATERIAL FABRIC ARE DESTROYED. THERE IS A LARGE CHANGE IN VOLUME, BUT THE SOIL HAS NOT BEEN SIGNIFICANTLY TRANSPORTED.

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTION D-D

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	4 of 24

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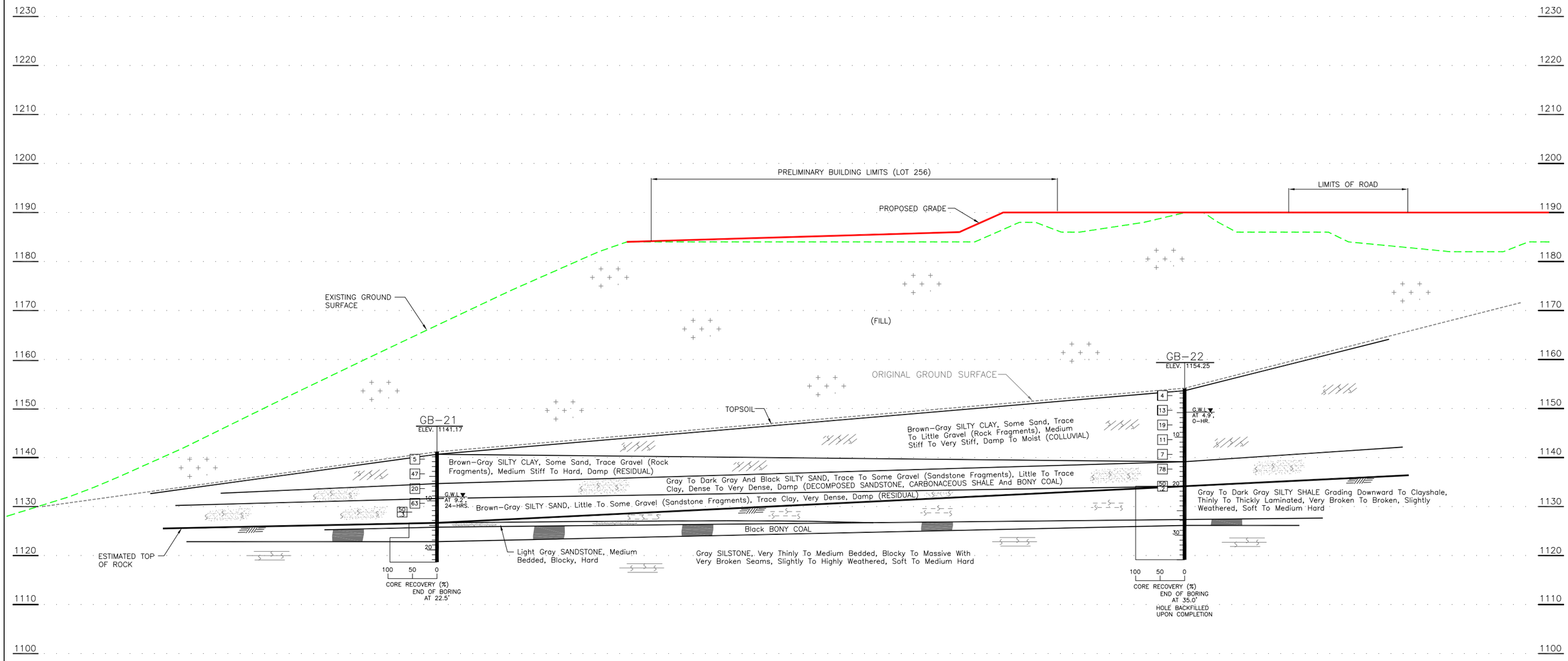

GEOLOGIC CROSS SECTION E-E

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
- LIMESTONE
- SANDSTONE
- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24-HRS. — GROUND WATER LEVEL
- (CL) — USCS CLASSIFICATION FROM TEST DATA

TERMINOLOGY FOR SOIL DESCRIPTION

CONSISTENCY OF COHESIVE SOILS		
CONSISTENCY	BLOWS/FOOT	UNCONFINED COMPRESSIVE STRENGTH, T.S.F.
V. SOFT	0 – 2	< 0.25
SOFT	3 – 4	0.25 TO 0.50
MED. STIFF	5 – 8	0.50 TO 1.0
STIFF	9 – 16	1.0 TO 1.5
V. STIFF	17 – 32	1.5 TO 2.0
HARD	> 32	> 2.0

DENSITY OF GRANULAR SOILS	
DESIGNATION	BLOWS PER FOOT
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
VERY DENSE	OVER 50

STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2-INCH O.D. SPLIT SPOON SAMPLER INTO THE SOILS USING A 140-POUND HAMMER FALLING FREELY THROUGH 30 INCHES. THE SAMPLER IS DRIVEN 18 INCHES, AND THE COMBINED NUMBER OF BLOWS FOR THE LAST TWO 6-INCH INTERVALS IS DESIGNATED AS STANDARD PENETRATION RESISTANCE (SPT N-VALUES).

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TERMINOLOGY FOR ROCK DESCRIPTION

DESCRIPTIVE TERMS	DEFINING CHARACTERISTICS OF HARDNESS OF ROCK CORES
VERY SOFT	CRUSHES UNDER PRESSURE OF FINGERS AND/OR THUMB
SOFT	CRUSHES UNDER PRESSURE OF PRESSED HAMMER
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DESCRIPTIVE TERMS	SPACING	
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THICKNESS OF BEDDING		
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THICKLY BEDDED	30 – 100cm.	12–40"
V. THICKLY BEDDED	> 1m.	>40"

TERMS USED TO DESCRIBE WEATHERING OF DISCONTINUITIES	
TERM	DESCRIPTION
FRESH OR UNWEATHERED	NO VISIBLE SIGN OF ROCK MATERIAL WEATHERING. PERHAPS SLIGHT DISCOLORATION ON MAJOR DISCONTINUITY SURFACES.
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RESIDUAL SOIL	ALL ROCK MATERIAL IS CONVERTED TO SOIL. THE MASS STRUCTURE AND MATERIAL FABRIC ARE DESTROYED. THERE IS A LARGE CHANGE IN VOLUME, BUT THE SOIL HAS NOT BEEN SIGNIFICANTLY TRANSPORTED.

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTION E-E

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	5 of 24

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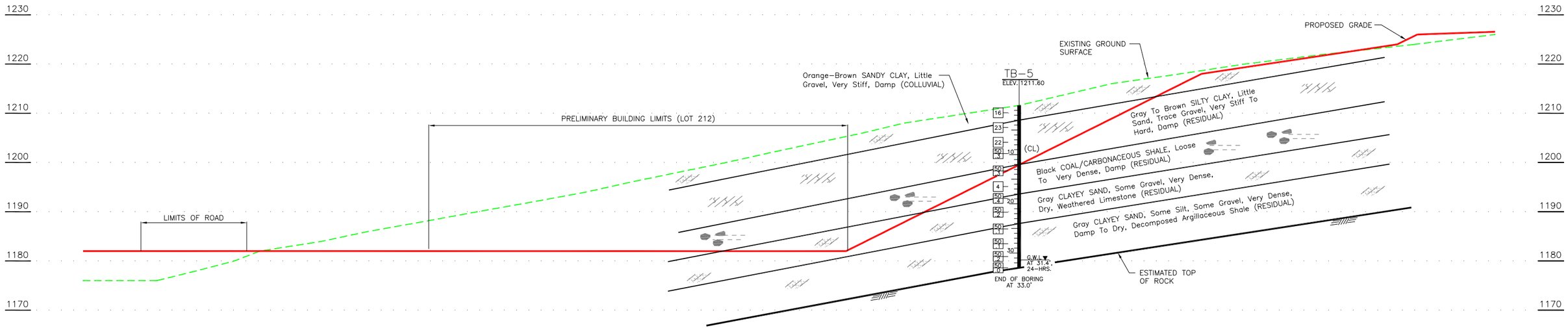

GEOLOGIC CROSS SECTION F–F

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
- LIMESTONE
- SANDSTONE
- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1', 24–HRS. — GROUND WATER LEVEL
- (CL) – USCS CLASSIFICATION FROM TEST DATA

TERMINOLOGY FOR SOIL DESCRIPTION

CONSISTENCY OF COHESIVE SOILS		
CONSISTENCY	BLOWS/FOOT	UNCONFINED COMPRESSIVE STRENGTH, T.S.F.
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SOFT	3 – 4	0.25 TO 0.50
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HARD	> 32	> 2.0

DENSITY OF GRANULAR SOILS	
DESIGNATION	BLOWS PER FOOT
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
VERY DENSE	OVER 50

STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2–INCH O.D. SPLIT SPOON SAMPLER INTO THE SOILS USING A 140–POUND HAMMER FALLING FREELY THROUGH 30 INCHES. THE SAMPLER IS DRIVEN 18 INCHES, AND THE COMBINED NUMBER OF BLOWS FOR THE LAST TWO 6–INCH INTERVALS IS DESIGNATED AS STANDARD PENETRATION RESISTANCE (SPT N–VALUES).

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TERMINOLOGY FOR ROCK DESCRIPTION

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THICKNESS OF BEDDING		
DESCRIPTIVE TERMS	THICKNESS	
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TERMS USED TO DESCRIBE WEATHERING OF DISCONTINUITIES	
TERM	DESCRIPTION
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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTION F–F

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	6 of 24

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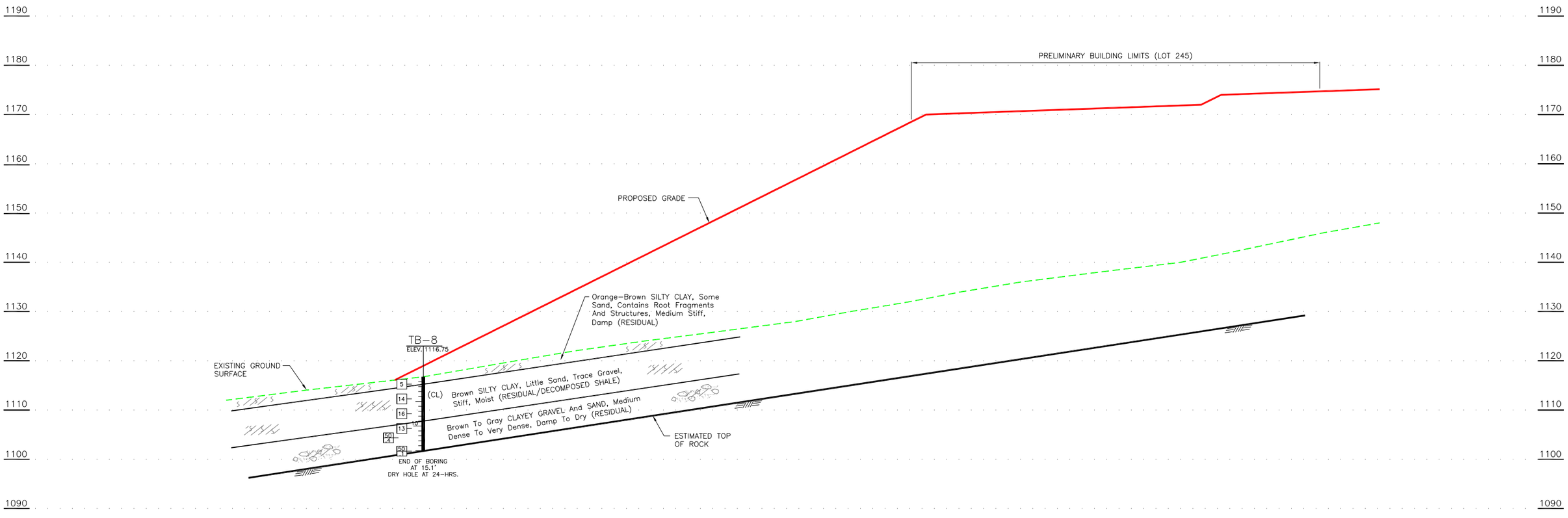

GEOLOGIC CROSS SECTION G–G

VERT. 0 10 20

HORZ. 0 10 20

SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
- LIMESTONE
- SANDSTONE
- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24–HRS. GROUND WATER LEVEL
- (CL) – USCS CLASSIFICATION FROM TEST DATA

TERMINOLOGY FOR SOIL DESCRIPTION

CONSISTENCY OF COHESIVE SOILS		
CONSISTENCY	BLOWS/FOOT	UNCONFINED COMPRESSIVE STRENGTH, T.S.F.
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HARD	> 32	> 2.0

DENSITY OF GRANULAR SOILS	
DESIGNATION	BLOWS PER FOOT
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
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STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2–INCH O.D. SPLIT SPOON SAMPLER INTO THE SOILS USING A 140–POUND HAMMER FALLING FREELY THROUGH 30 INCHES. THE SAMPLER IS DRIVEN 18 INCHES, AND THE COMBINED NUMBER OF BLOWS FOR THE LAST TWO 6–INCH INTERVALS IS DESIGNATED AS STANDARD PENETRATION RESISTANCE (SPT N–VALUES).

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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTION G–G

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	7 of 24

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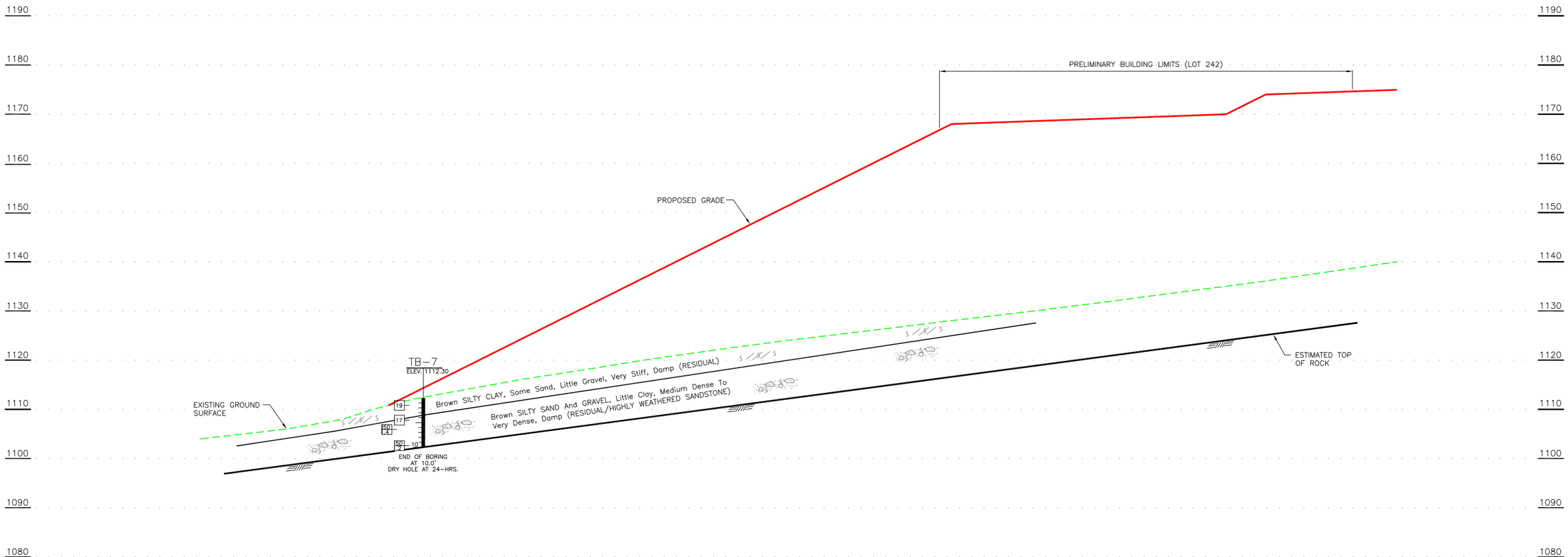

GEOLOGIC CROSS SECTION H–H

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTION H–H

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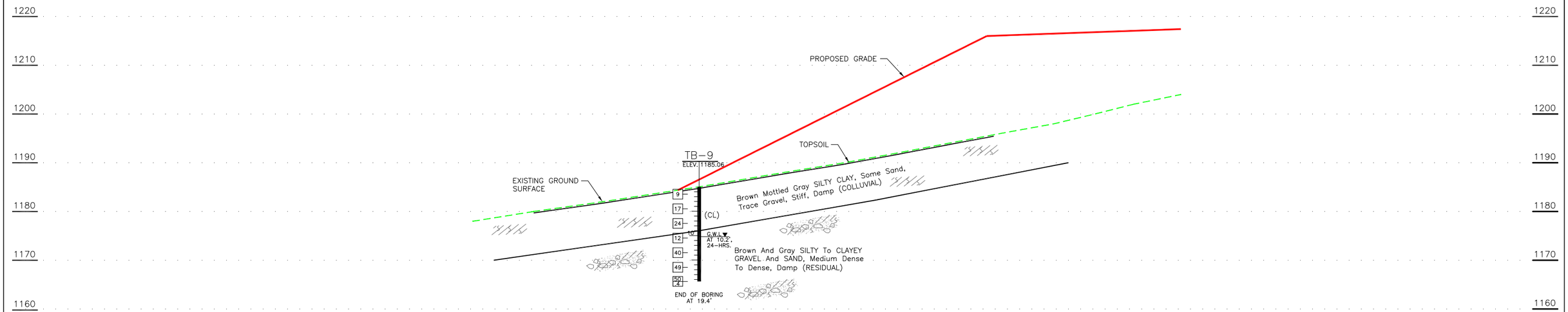
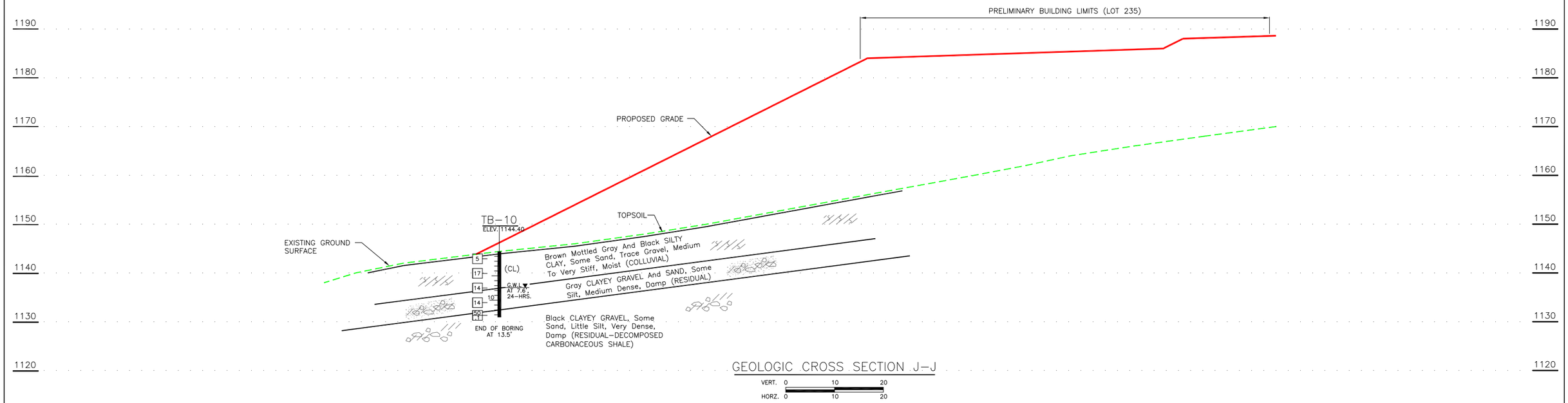
E–Mail: gmi@geo–mechanics.com



GEOLOGIC CROSS SECTION I–I

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET



GEOLOGIC CROSS SECTION J–J

VERT. 0 10 20
HORZ. 0 10 20

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
- LIMESTONE
- SANDSTONE
- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24–HRS. GROUND WATER LEVEL
- (CL) – USCS CLASSIFICATION FROM TEST DATA

TERMINOLOGY FOR SOIL DESCRIPTION

CONSISTENCY OF COHESIVE SOILS		
CONSISTENCY	BLOWS/FOOT	UNCONFINED COMPRESSIVE STRENGTH, T.S.F.
V. SOFT	0 – 2	< 0.25
SOFT	3 – 4	0.25 TO 0.50
MED. STIFF	5 – 8	0.50 TO 1.0
STIFF	9 – 16	1.0 TO 1.5
V. STIFF	17 – 32	1.5 TO 2.0
HARD	> 32	> 2.0

DENSITY OF GRANULAR SOILS	
DESIGNATION	BLOWS PER FOOT
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
VERY DENSE	OVER 50

STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2–INCH O.D. SPLIT SPOON SAMPLER INTO THE SOILS USING A 140–POUND HAMMER FALLING FREELY THROUGH 30 INCHES. THE SAMPLER IS DRIVEN 18 INCHES, AND THE COMBINED NUMBER OF BLOWS FOR THE LAST TWO 6–INCH INTERVALS IS DESIGNATED AS STANDARD PENETRATION RESISTANCE (SPT N–VALUES).

THE DEPTH AND THICKNESS OF THE SOIL AND ROCK STRATA INDICATED ON THESE GEOLOGIC CROSS SECTIONS ARE GENERALIZED FROM AND INTERPOLATED BETWEEN THE TEST BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS. IT IS POSSIBLE THAT SUBSURFACE CONDITIONS BETWEEN THE TEST BORINGS MAY VARY FROM THOSE SHOWN.

TERMINOLOGY FOR ROCK DESCRIPTION

DESCRIPTIVE TERMS	DEFINING CHARACTERISTICS OF HARDNESS OF ROCK CORES
VERY SOFT	CRUSHES UNDER PRESSURE OF FINGERS AND/OR THUMB
SOFT	CRUSHES UNDER PRESSURE OF PRESSED HAMMER
MEDIUM HARD	BREAKS EASILY UNDER SINGLE HAMMER BLOW BUT WITH CRUMBLY EDGES
HARD	BREAKS UNDER ONE OR TWO STRONG HAMMER BLOWS BUT WITH RESISTANT SHARP EDGES
VERY HARD	BREAKS UNDER SEVERAL STRONG HAMMER BLOWS BUT WITH VERY RESISTANT SHARP EDGES AND MAY SPALL LEAVING CONCHOIDAL FRACTURES

SPACING OF DISCONTINUITIES		
DESCRIPTIVE TERMS	SPACING	
V. BROKEN	< 3 cm.	(<1")
BROKEN	3cm.–8cm.	(1"–3")
BLOCKY	8cm.–15cm.	(3"–6")
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THICKNESS OF BEDDING		
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THINLY LAMINATED	< 0.3cm.	<1/8"
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THINLY BEDDED	3 – 10cm.	1–4"
MEDIUM BEDDED	10 –30cm.	4–12"
THICKLY BEDDED	30 – 100cm.	12–40"
V. THICKLY BEDDED	> 1m.	>40"

TERMS USED TO DESCRIBE WEATHERING OF DISCONTINUITIES	
TERM	DESCRIPTION
FRESH OR UNWEATHERED	NO VISIBLE SIGN OF ROCK MATERIAL WEATHERING. PERHAPS SLIGHT DISCOLORATION ON MAJOR DISCONTINUITY SURFACES.
SLIGHTLY WEATHERED	DISCOLORATION INDICATES WEATHERING OF ROCK MATERIAL AND DISCONTINUITY SURFACES. ALL THE ROCK MATERIAL MAY BE DISCOLORED BY WEATHERING AND MAY BE SOMEWHAT WEAKER EXTERNALLY THAN IN ITS FRESH CONDITION.
HIGHLY WEATHERED	MORE THAN HALF OF THE ROCK MATERIAL IS DECOMPOSED AND/OR DISINTEGRATED TO A SOIL. FRESH OR DISCOLORED ROCK IS PRESENT EITHER AS A DISCONTINUOUS FRAMEWORK OR AS ROCK FRAGMENTS OR CORESTONES.
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RESIDUAL SOIL	ALL ROCK MATERIAL IS CONVERTED TO SOIL. THE MASS STRUCTURE AND MATERIAL FABRIC ARE DESTROYED. THERE IS A LARGE CHANGE IN VOLUME, BUT THE SOIL HAS NOT BEEN SIGNIFICANTLY TRANSPORTED.

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTIONS I–I AND J–J

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	9 of 24

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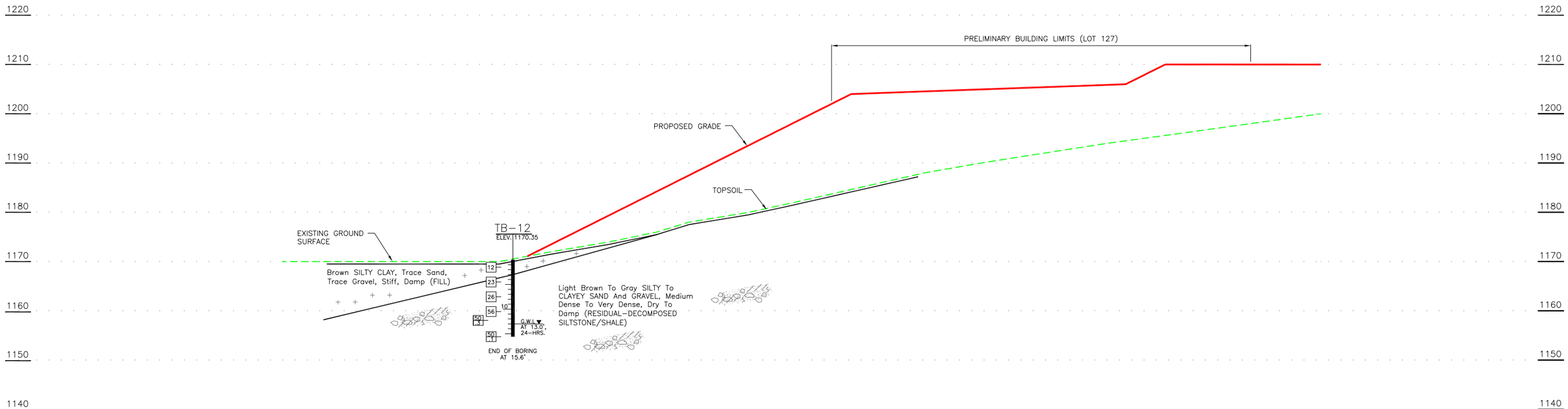

GEOLOGIC CROSS SECTION K–K

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
- LIMESTONE
- SANDSTONE
- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24–HRS. — GROUND WATER LEVEL
- (CL) — USCS CLASSIFICATION FROM TEST DATA

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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTION K–K

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	10 of 24

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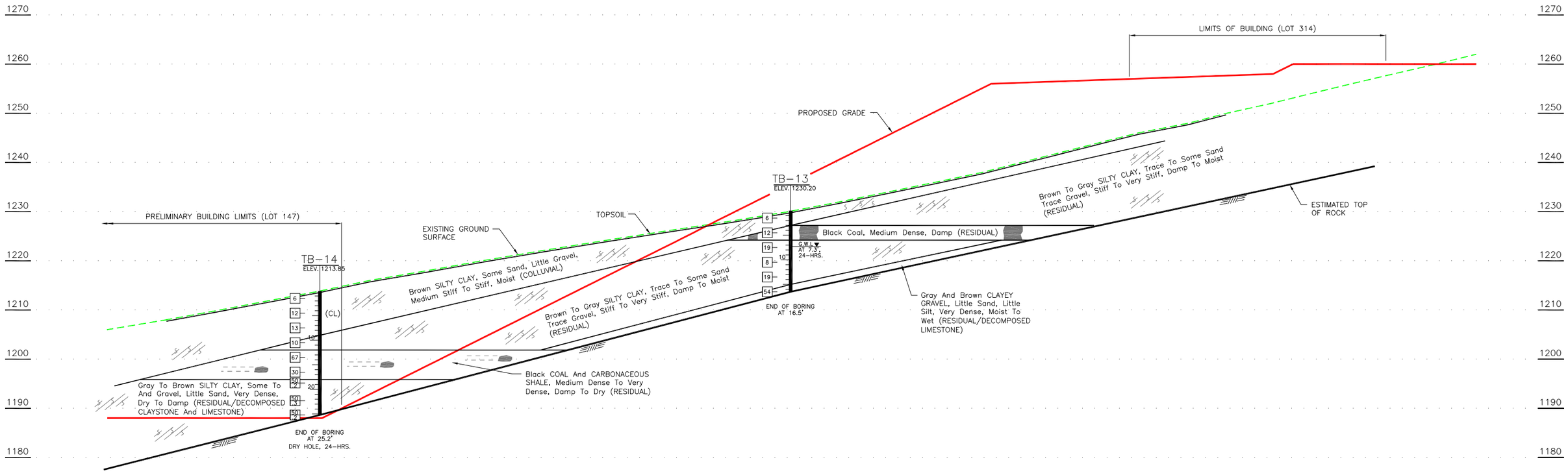

GEOLOGIC CROSS SECTION L-L

VERT. 0 10 20

HORZ. 0 10 20

SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
- LIMESTONE
- SANDSTONE
- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24-HRS. — GROUND WATER LEVEL
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DESCRIPTIVE TERMS	THICKNESS	
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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTION L-L

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	11 of 24

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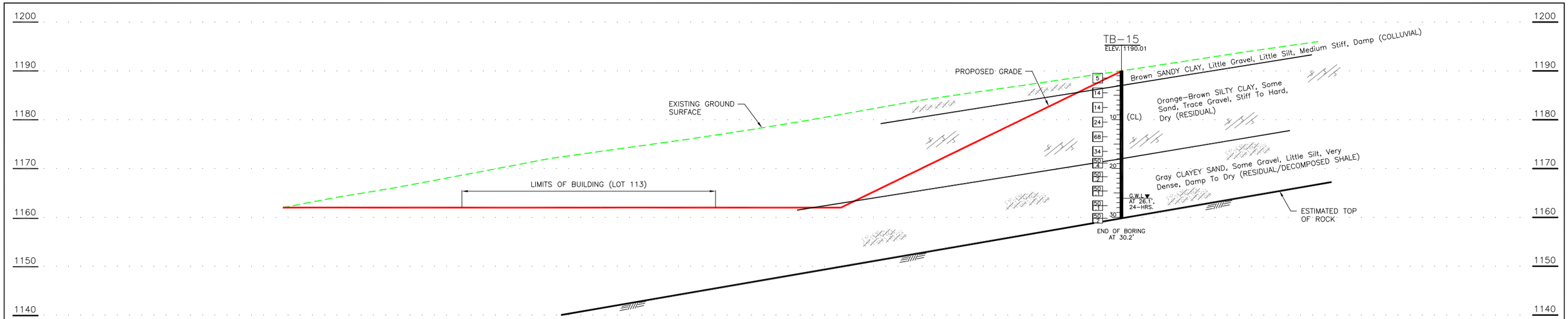
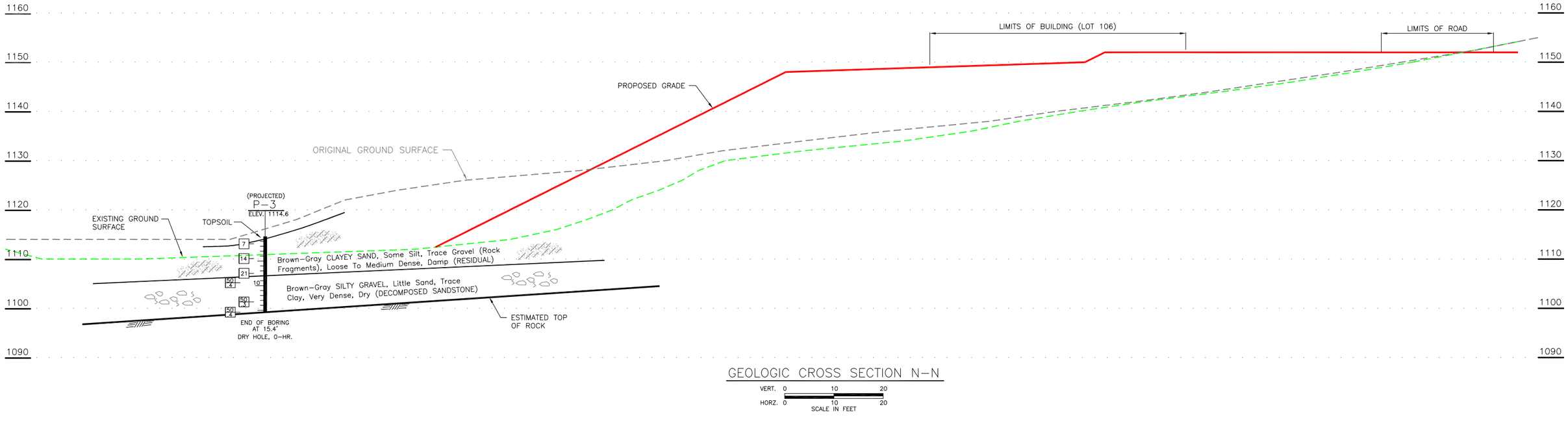


GEOLOGIC CROSS SECTION M-M

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET



GEOLOGIC CROSS SECTION N-N

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
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- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24-HRS. — GROUND WATER LEVEL
- (CL) — USCS CLASSIFICATION FROM TEST DATA

TERMINOLOGY FOR SOIL DESCRIPTION

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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTIONS M-M AND N-N

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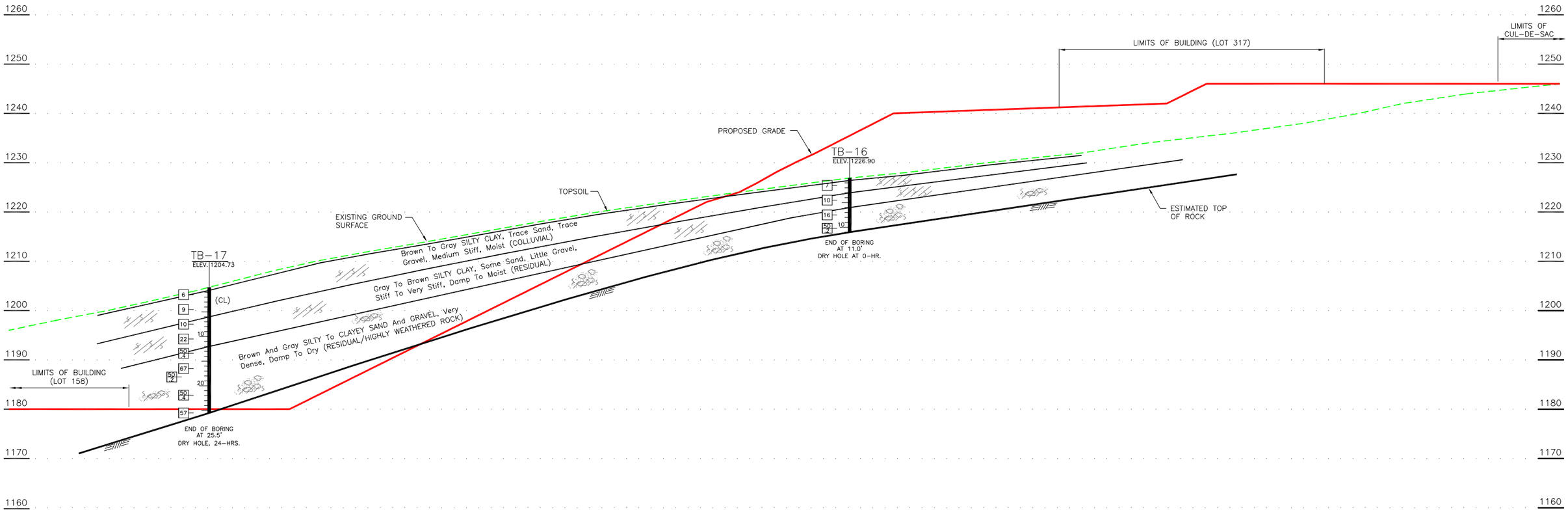

GEOLOGIC CROSS SECTION O-O

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

LEGEND

- CLAY
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SOFT	CRUSHES UNDER PRESSURE OF PRESSED HAMMER
MEDIUM HARD	BREAKS EASILY UNDER SINGLE HAMMER BLOW BUT WITH CRUMBLY EDGES
HARD	BREAKS UNDER ONE OR TWO STRONG HAMMER BLOWS BUT WITH RESISTANT SHARP EDGES
VERY HARD	BREAKS UNDER SEVERAL STRONG HAMMER BLOWS BUT WITH VERY RESISTANT SHARP EDGES AND MAY SPALL LEAVING CONCHOIDAL FRACTURES

SPACING OF DISCONTINUITIES		
DESCRIPTIVE TERMS	SPACING	
V. BROKEN	< 3 cm.	(<1")
BROKEN	3cm.-8cm.	(1"-3")
BLOCKY	8cm.-15cm.	(3"-6")
MASSIVE	> 15 cm.	(>6")

THICKNESS OF BEDDING		
DESCRIPTIVE TERMS	THICKNESS	
THINLY LAMINATED	< 0.3cm.	<1/8"
THICKLY LAMINATED	0.3 – 1cm.	1/8-1/2"
V. THINLY BEDDED	1 – 3cm.	1/2-1"
THINLY BEDDED	3 – 10cm.	1-4"
MEDIUM BEDDED	10 -30cm.	4-12"
THICKLY BEDDED	30 – 100cm.	12-40"
V. THICKLY BEDDED	> 1m.	>40"

TERMS USED TO DESCRIBE WEATHERING OF DISCONTINUITIES	
TERM	DESCRIPTION
FRESH OR UNWEATHERED	NO VISIBLE SIGN OF ROCK MATERIAL WEATHERING. PERHAPS SLIGHT DISCOLORATION ON MAJOR DISCONTINUITY SURFACES.
SLIGHTLY WEATHERED	DISCOLORATION INDICATES WEATHERING OF ROCK MATERIAL AND DISCONTINUITY SURFACES. ALL THE ROCK MATERIAL MAY BE DISCOLORED BY WEATHERING AND MAY BE SOMEWHAT WEAKER EXTERNALLY THAN IN ITS FRESH CONDITION.
HIGHLY WEATHERED	MORE THAN HALF OF THE ROCK MATERIAL IS DECOMPOSED AND/OR DISINTEGRATED TO A SOIL. FRESH OR DISCOLORED ROCK IS PRESENT EITHER AS A DISCONTINUOUS FRAMEWORK OR AS ROCK FRAGMENTS OR CORESTONES.
COMPLETELY WEATHERED	ALL ROCK MATERIAL IS DECOMPOSED AND/OR DISINTEGRATED TO SOIL. THE ORIGINAL MASS STRUCTURE IS STILL LARGELY INTACT.
RESIDUAL SOIL	ALL ROCK MATERIAL IS CONVERTED TO SOIL. THE MASS STRUCTURE AND MATERIAL FABRIC ARE DESTROYED. THERE IS A LARGE CHANGE IN VOLUME, BUT THE SOIL HAS NOT BEEN SIGNIFICANTLY TRANSPORTED.

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTION O-O

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	13 of 24

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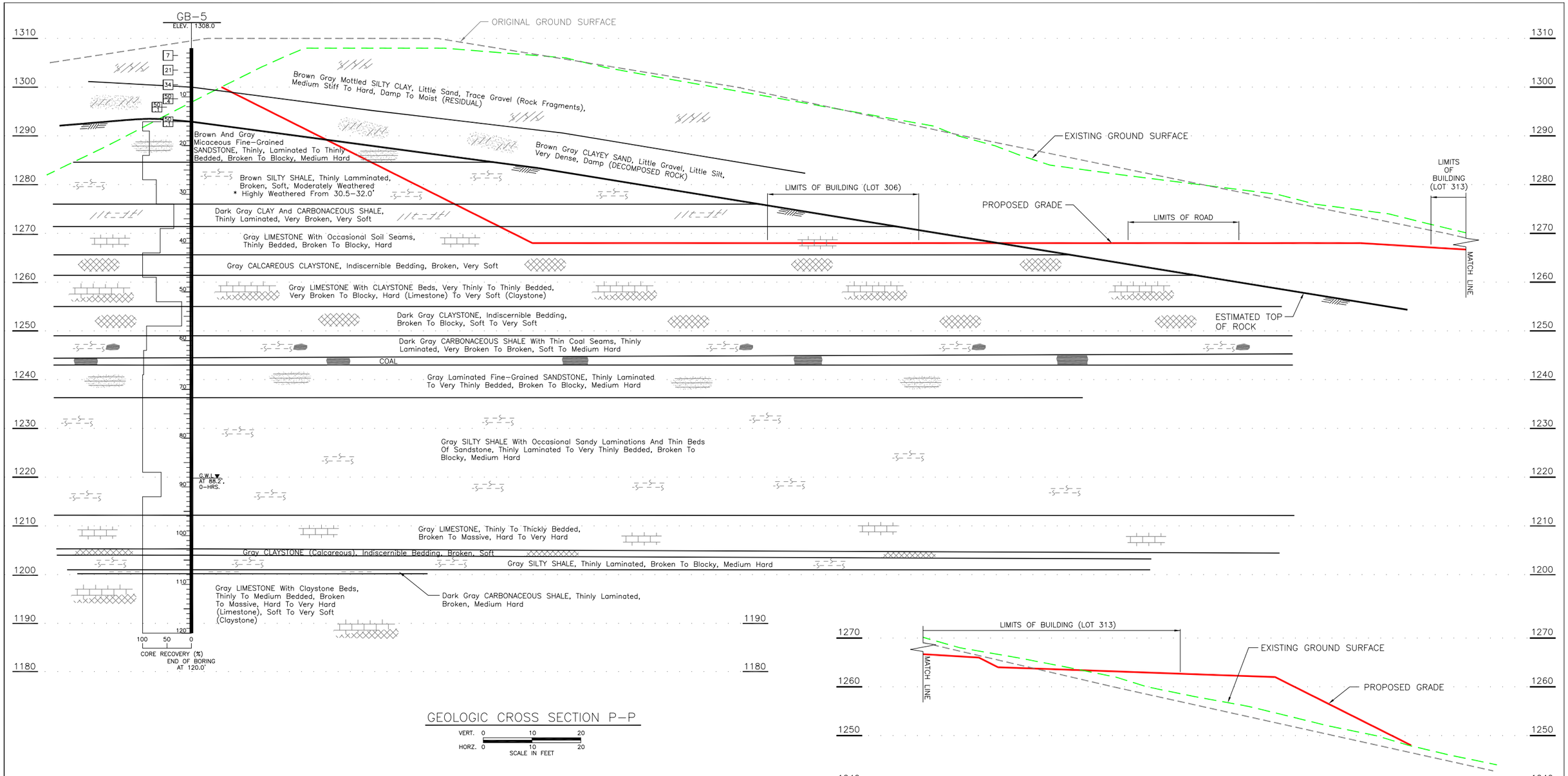

GEOLOGIC CROSS SECTION P-P

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
- LIMESTONE
- SANDSTONE
- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24-HRS. — GROUND WATER LEVEL
- (CL) — USCS CLASSIFICATION FROM TEST DATA

TERMINOLOGY FOR SOIL DESCRIPTION

CONSISTENCY OF COHESIVE SOILS		
CONSISTENCY	BLOWS/FOOT	UNCONFINED COMPRESSIVE STRENGTH, T.S.F.
V. SOFT	0 – 2	< 0.25
SOFT	3 – 4	0.25 TO 0.50
MED. STIFF	5 – 8	0.50 TO 1.0
STIFF	9 – 16	1.0 TO 1.5
V. STIFF	17 – 32	1.5 TO 2.0
HARD	> 32	> 2.0

DENSITY OF GRANULAR SOILS	
DESIGNATION	BLOWS PER FOOT
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
VERY DENSE	OVER 50

STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2-INCH O.D. SPLIT SPOON SAMPLER INTO THE SOILS USING A 140-POUND HAMMER FALLING FREELY THROUGH 30 INCHES. THE SAMPLER IS DRIVEN 18 INCHES, AND THE COMBINED NUMBER OF BLOWS FOR THE LAST TWO 6-INCH INTERVALS IS DESIGNATED AS STANDARD PENETRATION RESISTANCE (SPT N-VALUES).

THE DEPTH AND THICKNESS OF THE SOIL AND ROCK STRATA INDICATED ON THESE GEOLOGIC CROSS SECTIONS ARE GENERALIZED FROM AND INTERPOLATED BETWEEN THE TEST BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS. IT IS POSSIBLE THAT SUBSURFACE CONDITIONS BETWEEN THE TEST BORINGS MAY VARY FROM THOSE SHOWN.

TERMINOLOGY FOR ROCK DESCRIPTION

DESCRIPTIVE TERMS	DEFINING CHARACTERISTICS OF HARDNESS OF ROCK CORES
VERY SOFT	CRUSHES UNDER PRESSURE OF FINGERS AND/OR THUMB
SOFT	CRUSHES UNDER PRESSURE OF PRESSED HAMMER
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SPACING OF DISCONTINUITIES		
DESCRIPTIVE TERMS	SPACING	
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TERMS USED TO DESCRIBE WEATHERING OF DISCONTINUITIES	
TERM	DESCRIPTION
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HIGHLY WEATHERED	MORE THAN HALF OF THE ROCK MATERIAL IS DECOMPOSED AND/OR DISINTEGRATED TO A SOIL. FRESH OR DISCOLORED ROCK IS PRESENT EITHER AS A DISCONTINUOUS FRAMEWORK OR AS ROCK FRAGMENTS OR CORESTONES.
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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTION P-P

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
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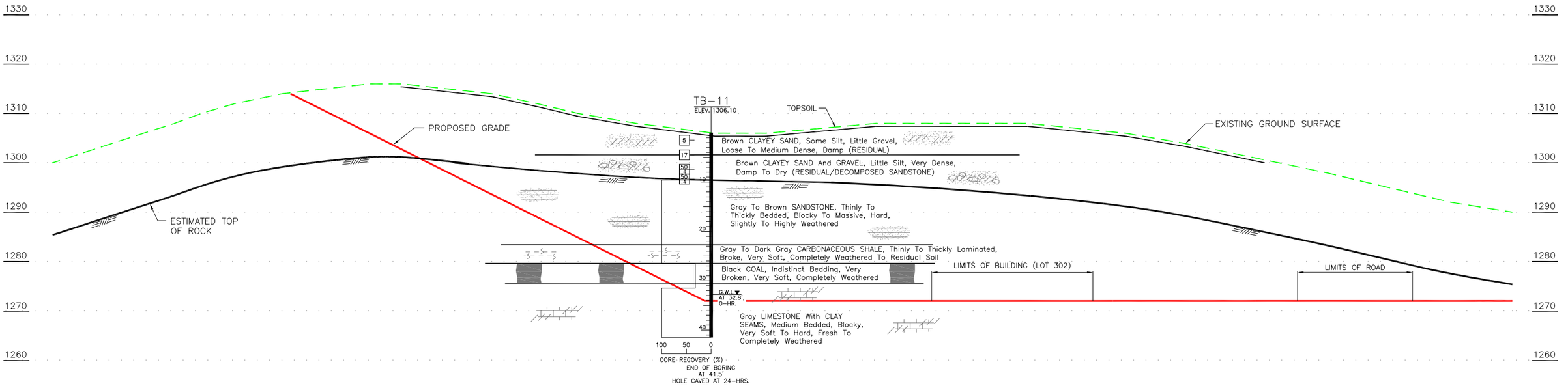

GEOLOGIC CROSS SECTION Q–Q

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
- LIMESTONE
- SANDSTONE
- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24–HRS. GROUND WATER LEVEL
- (CL) – USCS CLASSIFICATION FROM TEST DATA

TERMINOLOGY FOR SOIL DESCRIPTION

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DENSITY OF GRANULAR SOILS	
DESIGNATION	BLOWS PER FOOT
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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTION Q–Q

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
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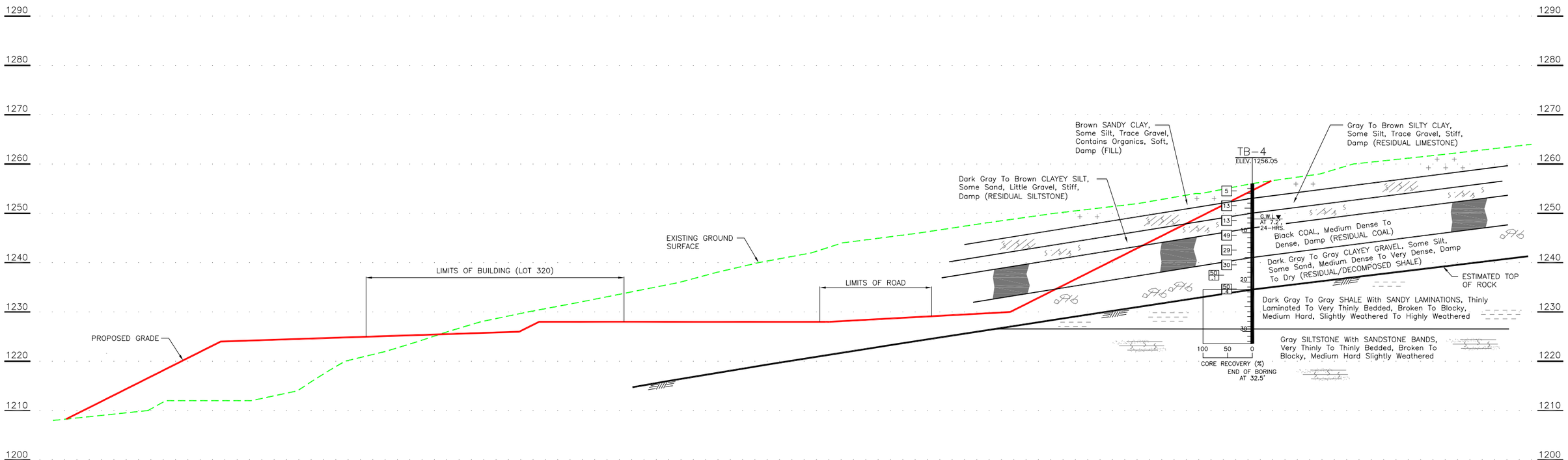

GEOLOGIC CROSS SECTION R-R

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
- LIMESTONE
- SANDSTONE
- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24-HRS. — GROUND WATER LEVEL
- (CL) — USCS CLASSIFICATION FROM TEST DATA

TERMINOLOGY FOR SOIL DESCRIPTION

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DENSITY OF GRANULAR SOILS	
DESIGNATION	BLOWS PER FOOT
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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTION R-R

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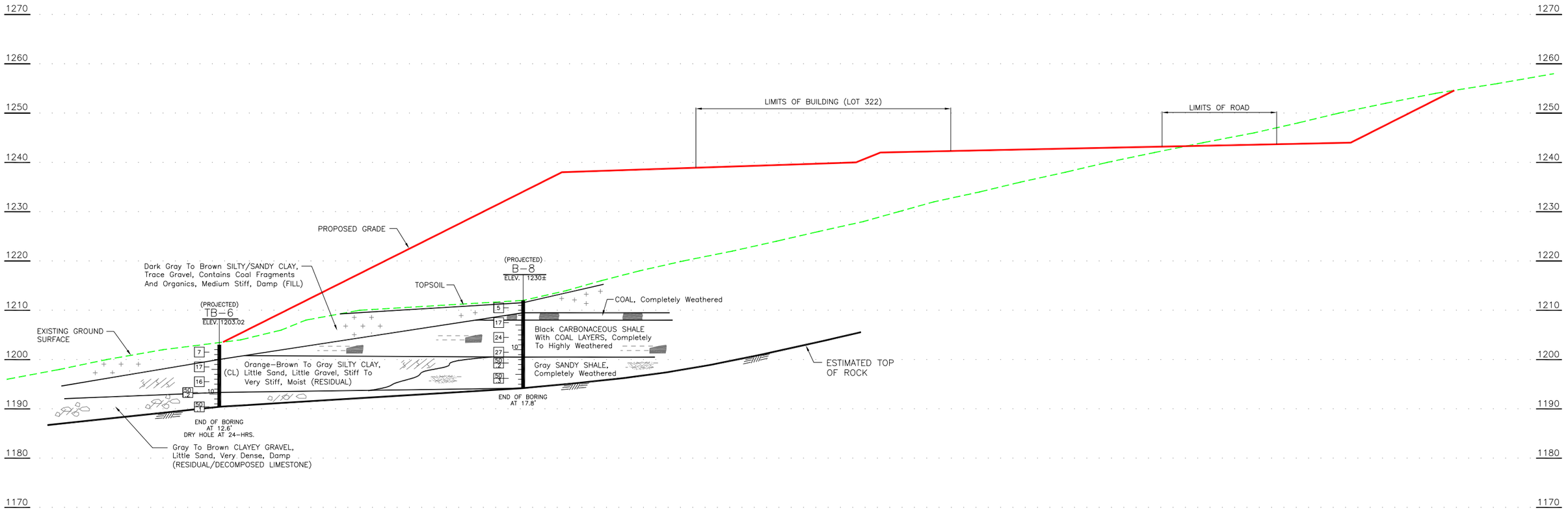

GEOLOGIC CROSS SECTION S-S

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC CROSS SECTION S-S

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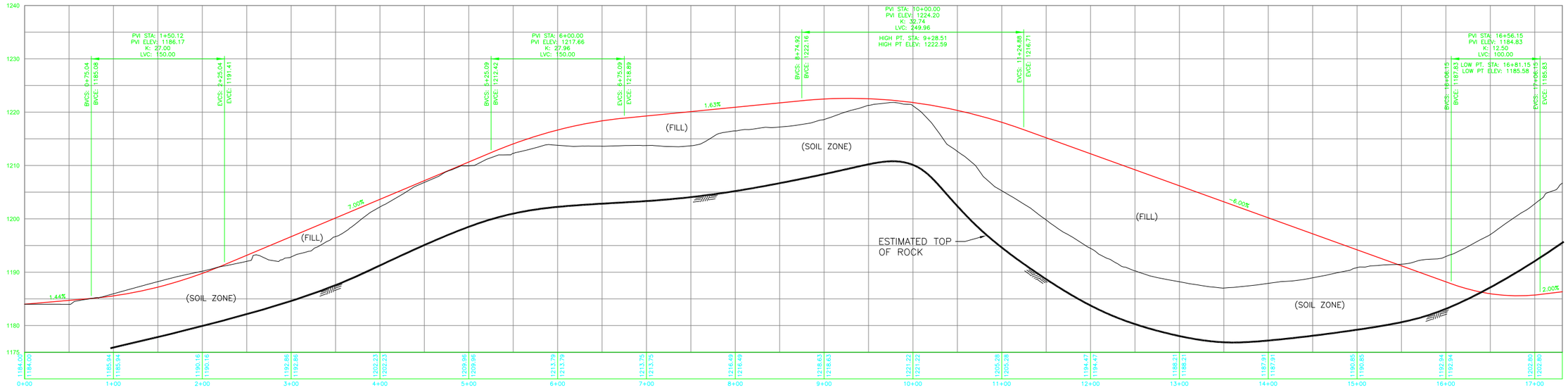

GEOLOGIC PROFILE (ROADWAY 01)

VERT. 0 10 20

HORZ. 0 60 120

SCALE IN FEETS

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
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TERMINOLOGY FOR SOIL DESCRIPTION

CONSISTENCY OF COHESIVE SOILS		
CONSISTENCY	BLOWS/FOOT	UNCONFINED COMPRESSIVE STRENGTH, T.S.F.
V. SOFT	0 – 2	< 0.25
SOFT	3 – 4	0.25 TO 0.50
MED. STIFF	5 – 8	0.50 TO 1.0
STIFF	9 – 16	1.0 TO 1.5
V. STIFF	17 – 32	1.5 TO 2.0
HARD	> 32	> 2.0

DENSITY OF GRANULAR SOILS	
DESIGNATION	BLOWS PER FOOT
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
VERY DENSE	OVER 50

STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2–INCH O.D. SPLIT SPOON SAMPLER INTO THE SOILS USING A 140–POUND HAMMER FALLING FREELY THROUGH 30 INCHES. THE SAMPLER IS DRIVEN 18 INCHES, AND THE COMBINED NUMBER OF BLOWS FOR THE LAST TWO 6–INCH INTERVALS IS DESIGNATED AS STANDARD PENETRATION RESISTANCE (SPT N–VALUES).

THE DEPTH AND THICKNESS OF THE SOIL AND ROCK STRATA INDICATED ON THESE GEOLOGIC CROSS SECTIONS ARE GENERALIZED FROM AND INTERPOLATED BETWEEN THE TEST BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS. IT IS POSSIBLE THAT SUBSURFACE CONDITIONS BETWEEN THE TEST BORINGS MAY VARY FROM THOSE SHOWN.

TERMINOLOGY FOR ROCK DESCRIPTION

DESCRIPTIVE TERMS	DEFINING CHARACTERISTICS OF HARDNESS OF ROCK CORES
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SOFT	CRUSHES UNDER PRESSURE OF PRESSED HAMMER
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SPACING OF DISCONTINUITIES		
DESCRIPTIVE TERMS	SPACING	
V. BROKEN	< 3 cm.	(<1")
BROKEN	3cm.–8cm.	(1"–3")
BLOCKY	8cm.–15cm.	(3"–6")
MASSIVE	> 15 cm.	(>6")

THICKNESS OF BEDDING		
DESCRIPTIVE TERMS	THICKNESS	
THINLY LAMINATED	< 0.3cm.	<1/8"
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THICKLY BEDDED	30 – 100cm.	12–40"
V. THICKLY BEDDED	> 1m.	>40"

TERMS USED TO DESCRIBE WEATHERING OF DISCONTINUITIES	
TERM	DESCRIPTION
FRESH OR UNWEATHERED	NO VISIBLE SIGN OF ROCK MATERIAL WEATHERING. PERHAPS SLIGHT DISCOLORATION ON MAJOR DISCONTINUITY SURFACES.
SLIGHTLY WEATHERED	DISCOLORATION INDICATES WEATHERING OF ROCK MATERIAL AND DISCONTINUITY SURFACES. ALL THE ROCK MATERIAL MAY BE DISCOLORED BY WEATHERING AND MAY BE SOMEWHAT WEAKER EXTERNALLY THAN IN ITS FRESH CONDITION.
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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC PROFILE (ROADWAY 01)

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	18 of 24

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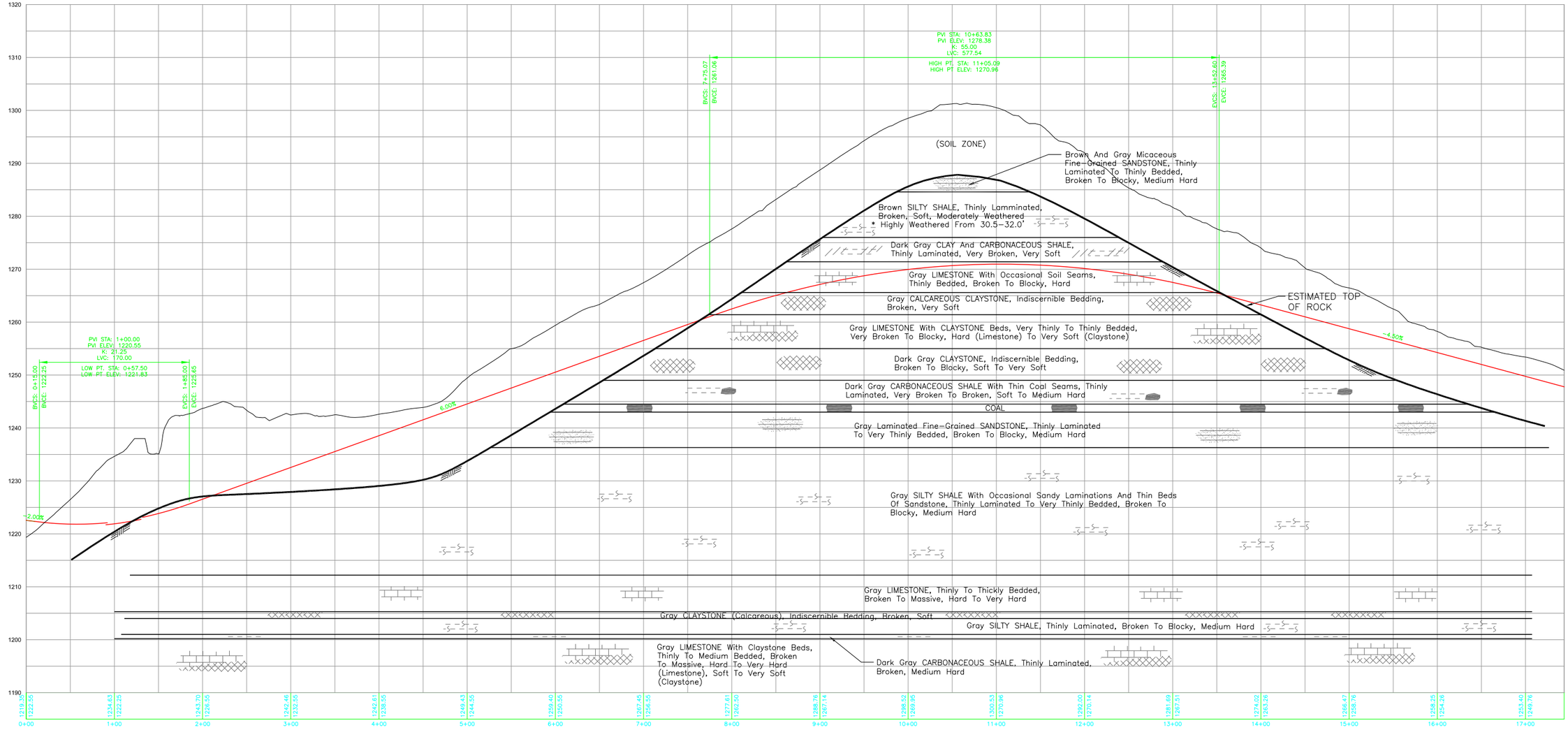

GEOLOGIC PROFILE (ROADWAY 02)

VERT. 0 10 20
HORZ. 0 60 120
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
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- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24-HRS. GROUND WATER LEVEL
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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC PROFILE (ROADWAY 02)

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	19 of 24

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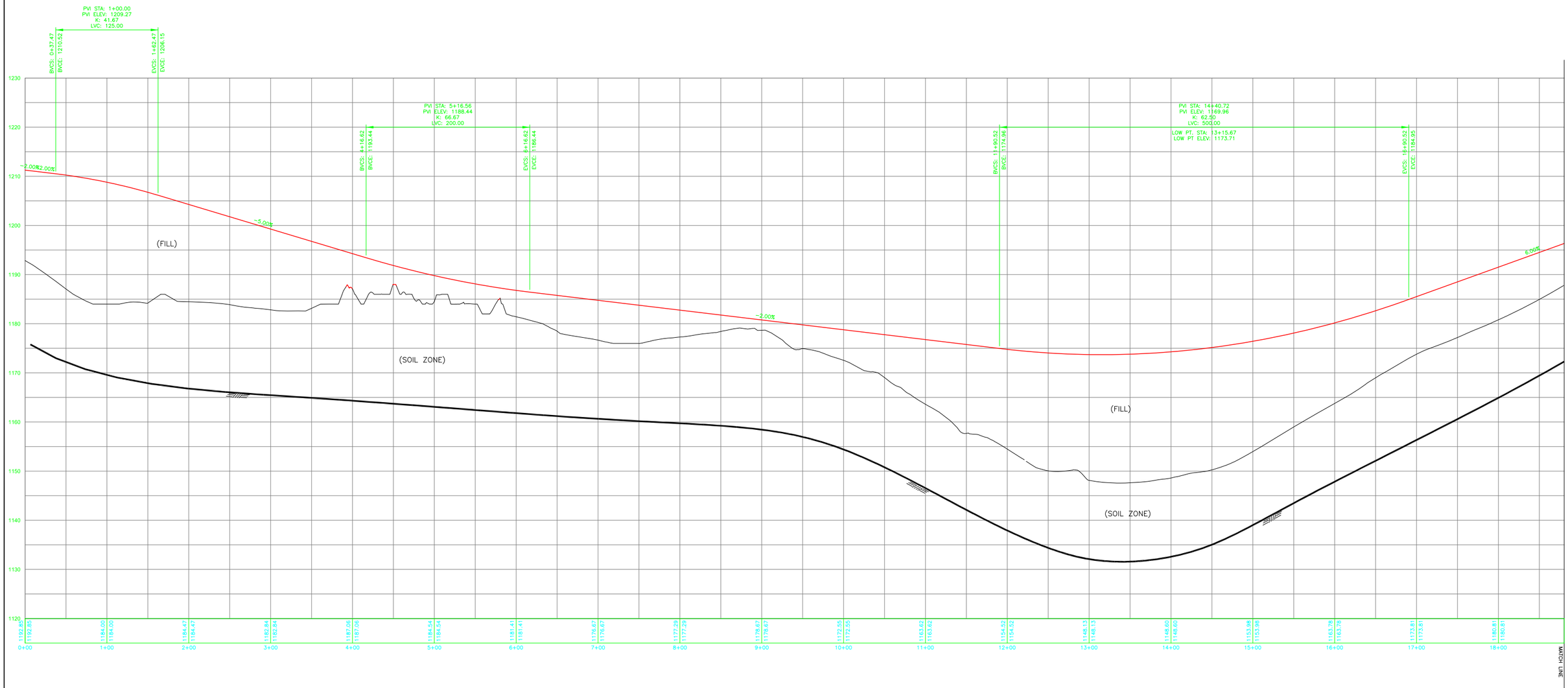

GEOLOGIC PROFILE (ROADWAY 03)

VERT. 0 10 20

HORZ. 0 60 120

SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC PROFILE (ROADWAY 03) (1 OF 2)

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	20 of 24

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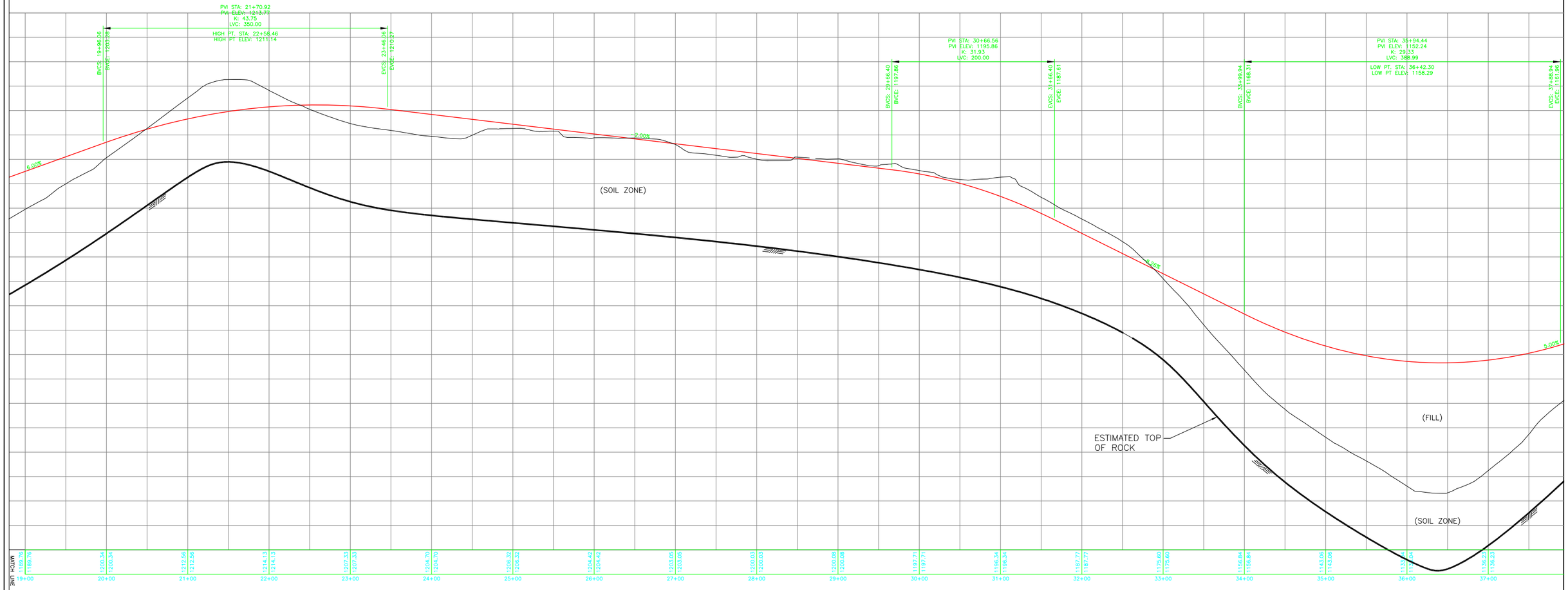

GEOLOGIC PROFILE (ROADWAY 03)

VERT. 0 10 20
HORZ. 0 60 120
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC PROFILE (ROADWAY 03) (2 OF 2)

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
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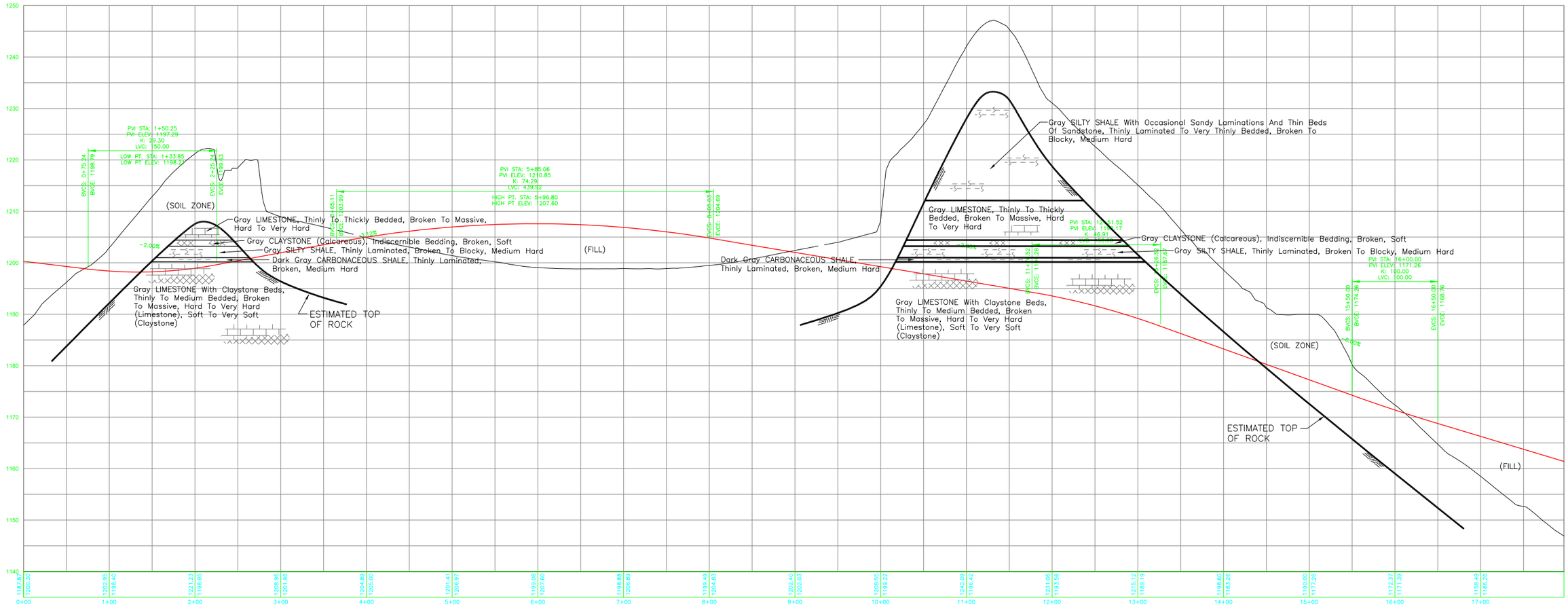

GEOLOGIC PROFILE (ROADWAY 04)

VERT. 0 10 20
HORZ. 0 60 120
SCALE IN FEET

LEGEND

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- SILT
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SLIGHTLY WEATHERED	DISCOLORATION INDICATES WEATHERING OF ROCK MATERIAL AND DISCONTINUITY SURFACES. ALL THE ROCK MATERIAL MAY BE DISCOLORED BY WEATHERING AND MAY BE SOMEWHAT WEAKER EXTERNALLY THAN IN ITS FRESH CONDITION.
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COMPLETELY WEATHERED	ALL ROCK MATERIAL IS DECOMPOSED AND/OR DISINTEGRATED TO SOIL. THE ORIGINAL MASS STRUCTURE IS STILL LARGELY INTACT.
RESIDUAL SOIL	ALL ROCK MATERIAL IS CONVERTED TO SOIL. THE MASS STRUCTURE AND MATERIAL FABRIC ARE DESTROYED. THERE IS A LARGE CHANGE IN VOLUME, BUT THE SOIL HAS NOT BEEN SIGNIFICANTLY TRANSPORTED.

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC PROFILE (ROADWAY 04)

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	22 of 24

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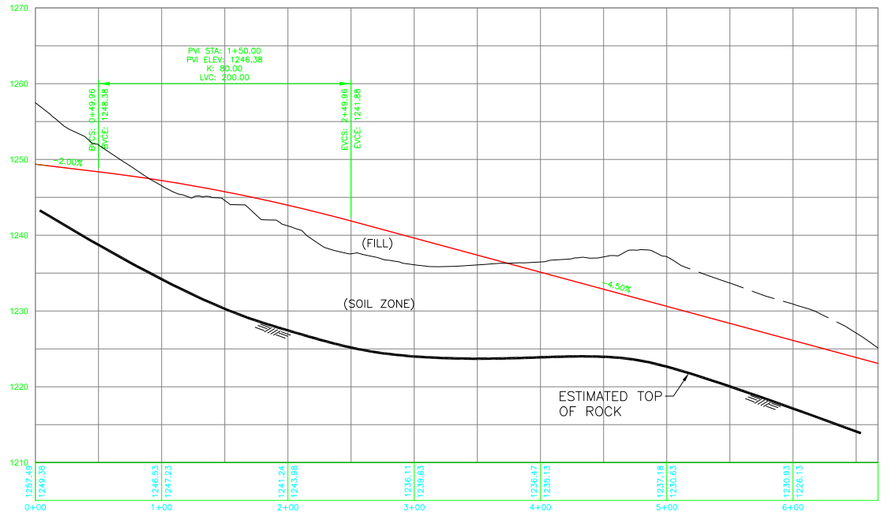

GEOLOGIC PROFILE (ROADWAY 05)

VERT. 0 10 20

HORZ. 0 60 120

SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
- LIMESTONE
- SANDSTONE
- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24-HRS. GROUND WATER LEVEL
- (CL) — USCS CLASSIFICATION FROM TEST DATA

TERMINOLOGY FOR SOIL DESCRIPTION

CONSISTENCY OF COHESIVE SOILS		
CONSISTENCY	BLOWS/FOOT	UNCONFINED COMPRESSIVE STRENGTH, T.S.F.
V. SOFT	0 – 2	< 0.25
SOFT	3 – 4	0.25 TO 0.50
MED. STIFF	5 – 8	0.50 TO 1.0
STIFF	9 – 16	1.0 TO 1.5
V. STIFF	17 – 32	1.5 TO 2.0
HARD	> 32	> 2.0

DENSITY OF GRANULAR SOILS	
DESIGNATION	BLOWS PER FOOT
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
VERY DENSE	OVER 50

STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2-INCH O.D. SPLIT SPOON SAMPLER INTO THE SOILS USING A 140-POUND HAMMER FALLING FREELY THROUGH 30 INCHES. THE SAMPLER IS DRIVEN 18 INCHES, AND THE COMBINED NUMBER OF BLOWS FOR THE LAST TWO 6-INCH INTERVALS IS DESIGNATED AS STANDARD PENETRATION RESISTANCE (SPT N-VALUES).

THE DEPTH AND THICKNESS OF THE SOIL AND ROCK STRATA INDICATED ON THESE GEOLOGIC CROSS SECTIONS ARE GENERALIZED FROM AND INTERPOLATED BETWEEN THE TEST BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS. IT IS POSSIBLE THAT SUBSURFACE CONDITIONS BETWEEN THE TEST BORINGS MAY VARY FROM THOSE SHOWN.

TERMINOLOGY FOR ROCK DESCRIPTION

DESCRIPTIVE TERMS	DEFINING CHARACTERISTICS OF HARDNESS OF ROCK CORES
VERY SOFT	CRUSHES UNDER PRESSURE OF FINGERS AND/OR THUMB
SOFT	CRUSHES UNDER PRESSURE OF PRESSED HAMMER
MEDIUM HARD	BREAKS EASILY UNDER SINGLE HAMMER BLOW BUT WITH CRUMBLY EDGES
HARD	BREAKS UNDER ONE OR TWO STRONG HAMMER BLOWS BUT WITH RESISTANT SHARP EDGES
VERY HARD	BREAKS UNDER SEVERAL STRONG HAMMER BLOWS BUT WITH VERY RESISTANT SHARP EDGES AND MAY SPALL LEAVING CONCHOIDAL FRACTURES

SPACING OF DISCONTINUITIES		
DESCRIPTIVE TERMS	SPACING	
V. BROKEN	< 3 cm.	(<1")
BROKEN	3cm.–8cm.	(1"–3")
BLOCKY	8cm.–15cm.	(3"–6")
MASSIVE	> 15 cm.	(>6")

THICKNESS OF BEDDING		
DESCRIPTIVE TERMS	THICKNESS	
THINLY LAMINATED	< 0.3cm.	<1/8"
THICKLY LAMINATED	0.3 – 1cm.	1/8–1/2"
V. THINLY BEDDED	1 – 3cm.	1/2–1"
THINLY BEDDED	3 – 10cm.	1–4"
MEDIUM BEDDED	10 –30cm.	4–12"
THICKLY BEDDED	30 – 100cm.	12–40"
V. THICKLY BEDDED	> 1m.	>40"

TERMS USED TO DESCRIBE WEATHERING OF DISCONTINUITIES	
TERM	DESCRIPTION
FRESH OR UNWEATHERED	NO VISIBLE SIGN OF ROCK MATERIAL WEATHERING. PERHAPS SLIGHT DISCOLORATION ON MAJOR DISCONTINUITY SURFACES.
SLIGHTLY WEATHERED	DISCOLORATION INDICATES WEATHERING OF ROCK MATERIAL AND DISCONTINUITY SURFACES. ALL THE ROCK MATERIAL MAY BE DISCOLORED BY WEATHERING AND MAY BE SOMEWHAT WEAKER EXTERNALLY THAN IN ITS FRESH CONDITION.
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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC PROFILE (ROADWAY 05)

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	23 of 24

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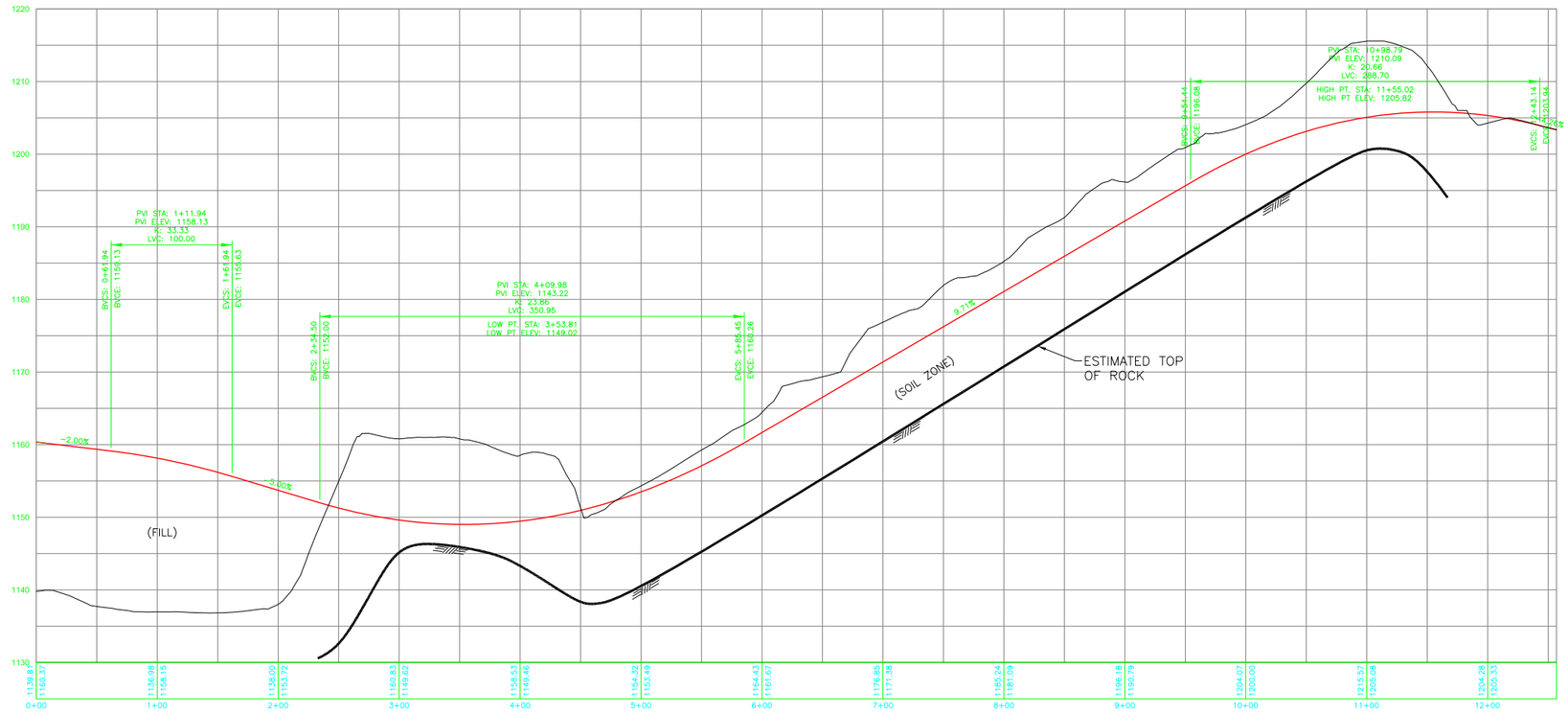

GEOLOGIC PROFILE (ROADWAY 06)

VERT. 0 10 20
HORZ. 0 60 120
SCALE IN FEET

LEGEND

- CLAY
- SILT
- SAND
- ROCK FRAGMENTS
- SILTSTONE
- SHALE
- CLAYSTONE
- LIMESTONE
- SANDSTONE
- 10 — STANDARD PENETRATION RESISTANCE
- G.W.L. ▼ AT 5.1' 24-HRS. — GROUND WATER LEVEL
- (CL) — USCS CLASSIFICATION FROM TEST DATA

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CONSISTENCY	BLOWS/FOOT	UNCONFINED COMPRESSIVE STRENGTH, T.S.F.
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SOFT	3 – 4	0.25 TO 0.50
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STIFF	9 – 16	1.0 TO 1.5
V. STIFF	17 – 32	1.5 TO 2.0
HARD	> 32	> 2.0

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DESCRIPTIVE TERMS	THICKNESS	
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THICKLY LAMINATED	0.3 – 1cm.	1/8–1/2"
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THINLY BEDDED	3 – 10cm.	1–4"
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MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

GEOLOGIC PROFILE (ROADWAY 06)

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	24 of 24

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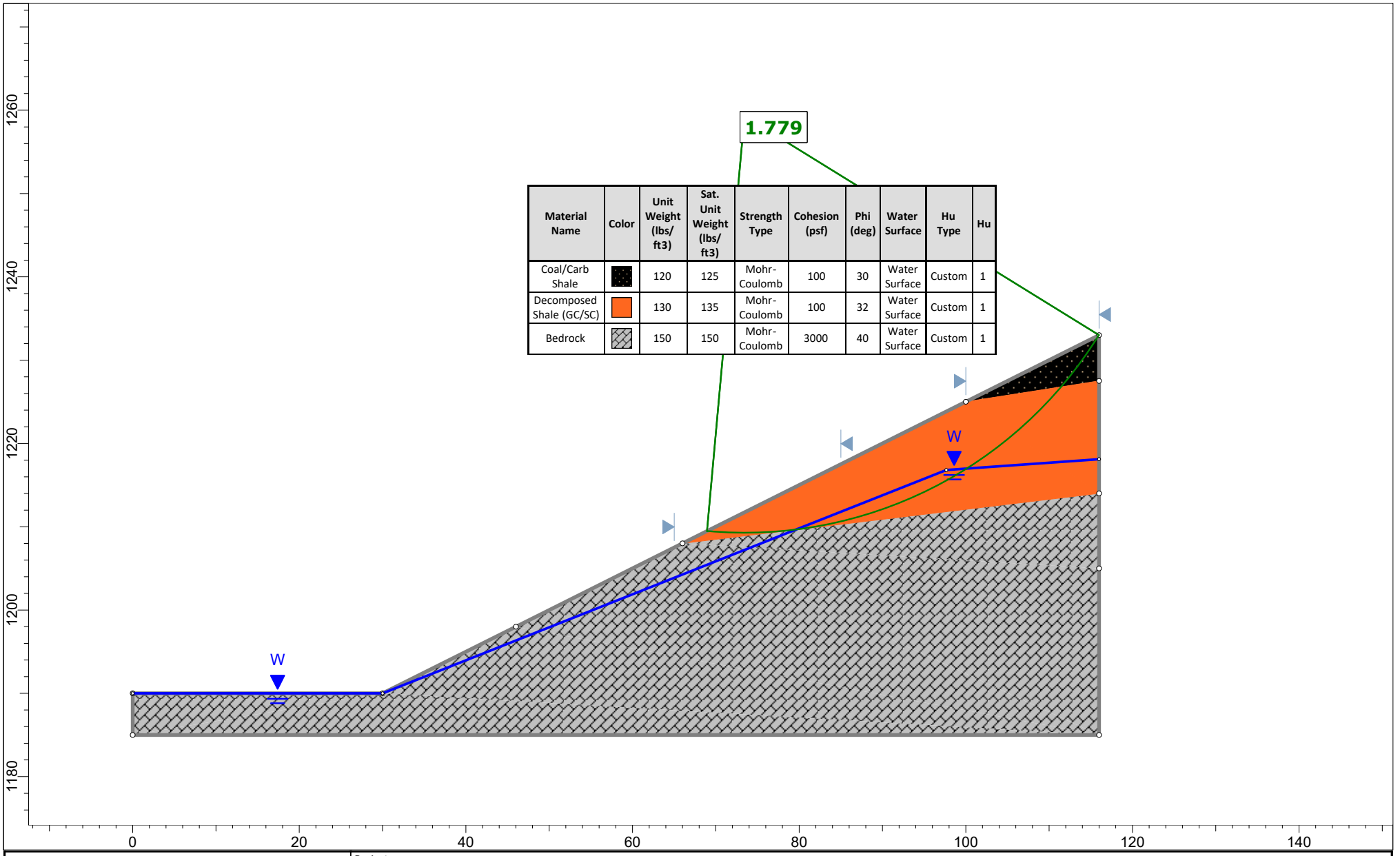
E-Mail: gmi@geo-mechanics.com

APPENDIX D
Slope Stability Analyses

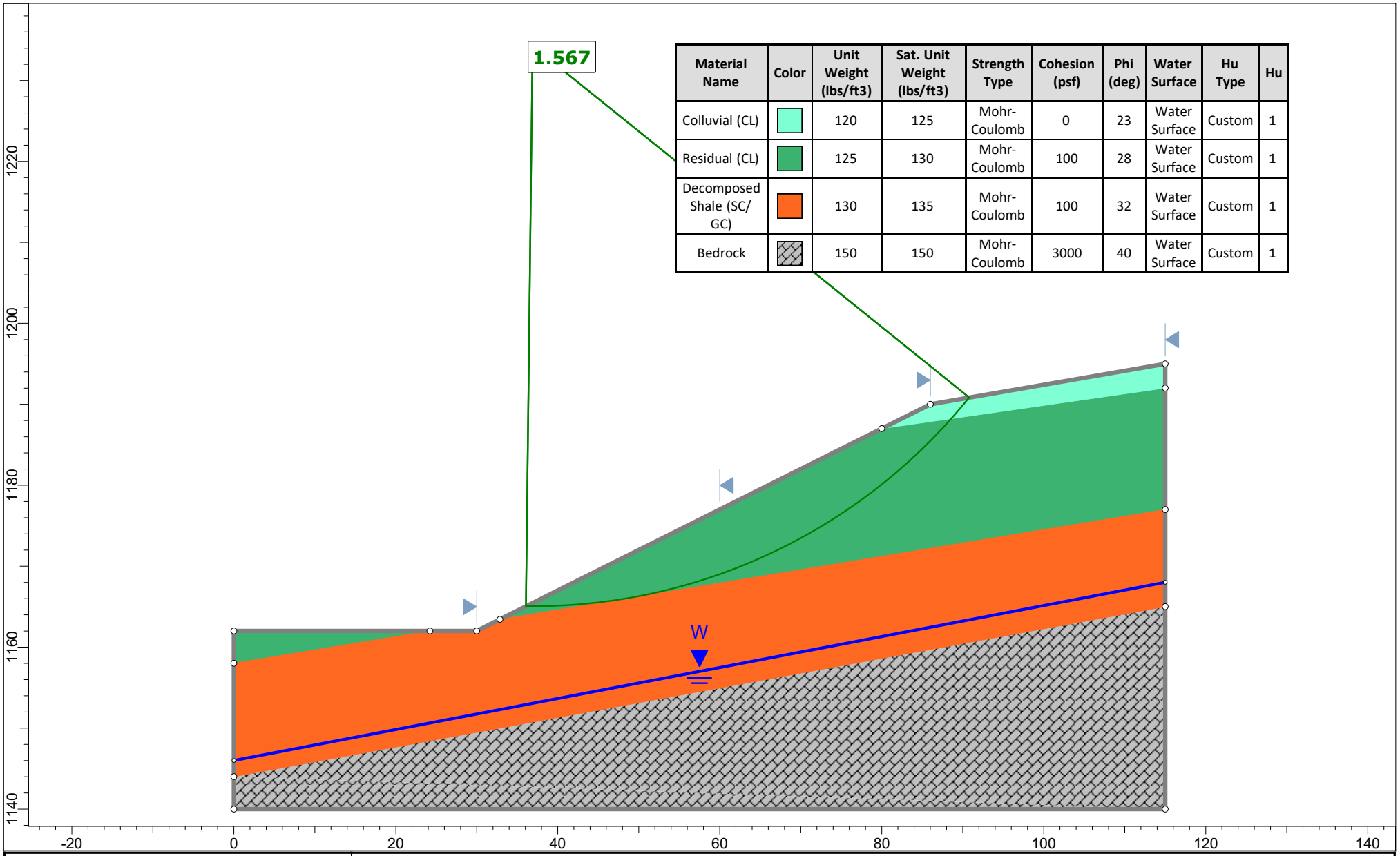


Material Name	Color	Unit Weight (lbs/ ft3)	Sat. Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Coal/Carb Shale		120	125	Mohr-Coulomb	100	30	Water Surface	Custom	1
Decomposed Shale (GC/SC)		130	135	Mohr-Coulomb	100	32	Water Surface	Custom	1
Bedrock		150	150	Mohr-Coulomb	3000	40	Water Surface	Custom	1

rocscience

SLIDEINTERPRET 9.012

Project	21016 - Meadows Landing Residential Development		
Group	Section A-A Cut Slope	*Scenario*	Master Scenario
Drawn By	RJK	*Company*	GMI
Date	5/6/2021, 11:33:44 AM	*File Name*	Section A-A.slmd

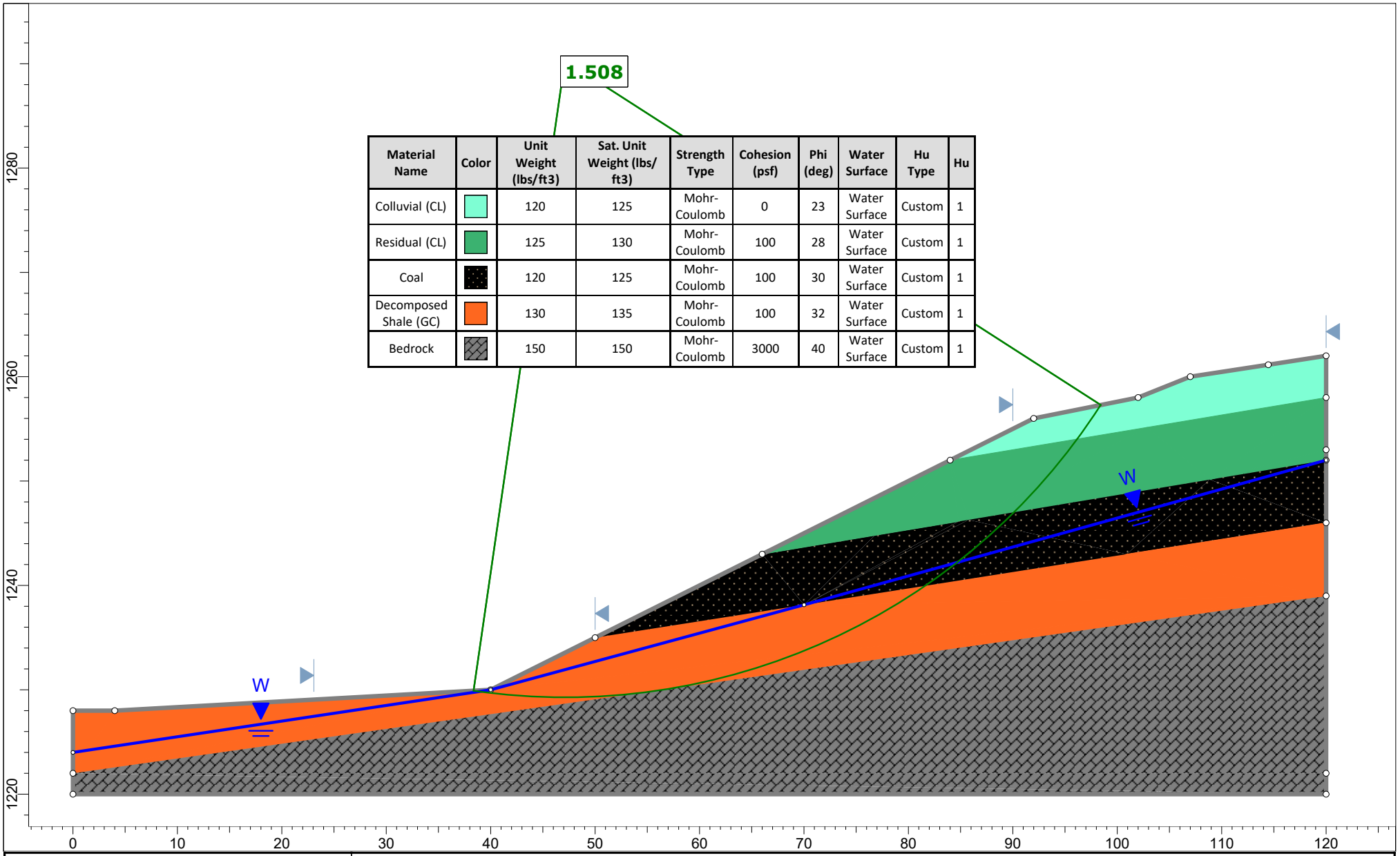


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Colluvial (CL)		120	125	Mohr-Coulomb	0	23	Water Surface	Custom	1
Residual (CL)		125	130	Mohr-Coulomb	100	28	Water Surface	Custom	1
Decomposed Shale (SC/GC)		130	135	Mohr-Coulomb	100	32	Water Surface	Custom	1
Bedrock		150	150	Mohr-Coulomb	3000	40	Water Surface	Custom	1

rocscience

SLIDEINTERPRET 9.012

Project	Meadows Landing		
Group	Section M-M Cut Slope	*Scenario*	Master Scenario
Drawn By	RJK	*Company*	GMI
Date	4/29/2021, 3:41:45 PM	*File Name*	Section M-M.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Colluvial (CL)		120	125	Mohr-Coulomb	0	23	Water Surface	Custom	1
Residual (CL)		125	130	Mohr-Coulomb	100	28	Water Surface	Custom	1
Coal		120	125	Mohr-Coulomb	100	30	Water Surface	Custom	1
Decomposed Shale (GC)		130	135	Mohr-Coulomb	100	32	Water Surface	Custom	1
Bedrock		150	150	Mohr-Coulomb	3000	40	Water Surface	Custom	1

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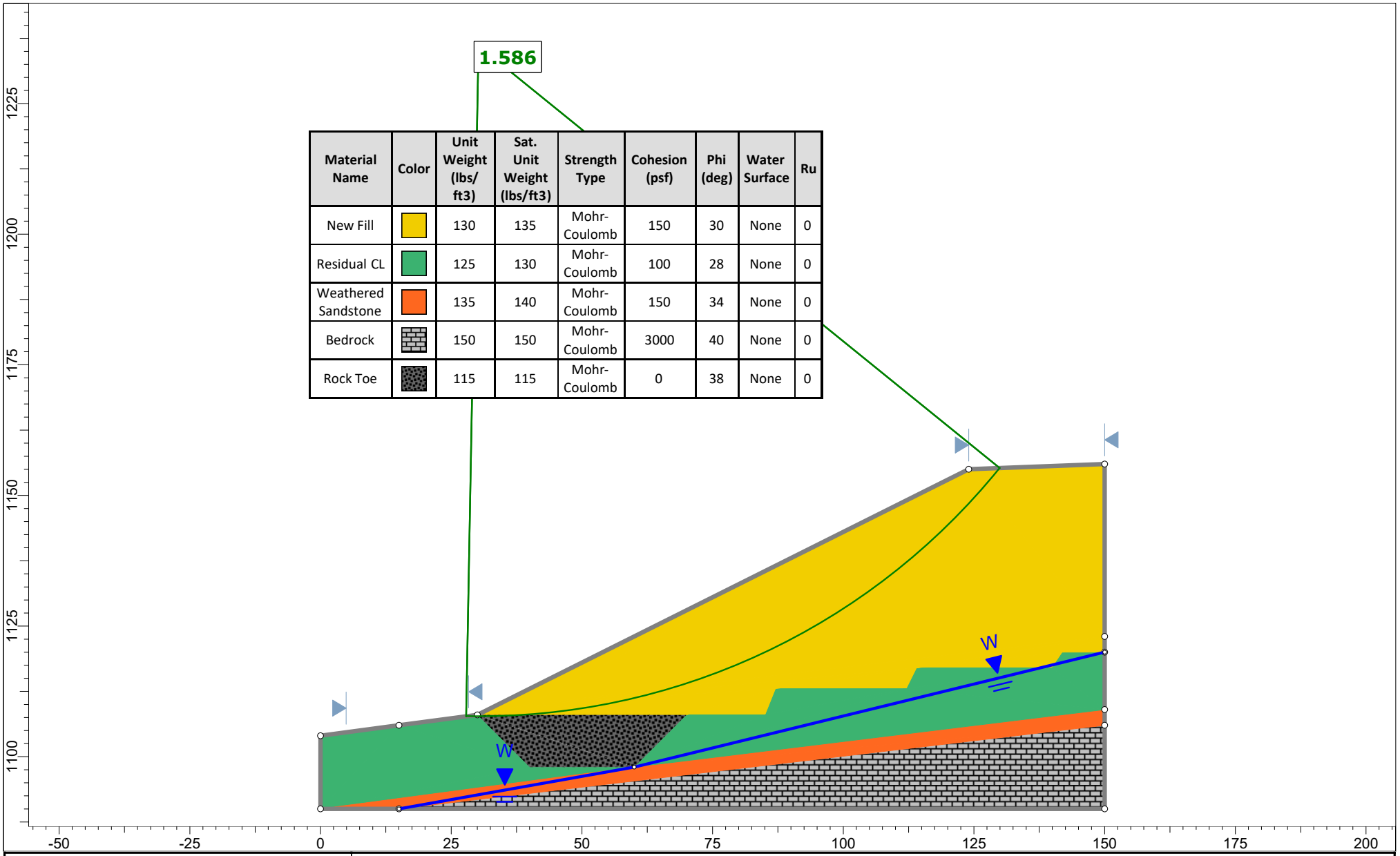
SLIDEINTERPRET 9.012

Project	21016 - Meadows Landing		
Group	Section R-R Cut Slope	*Scenario*	Master Scenario
Drawn By	RJK	*Company*	GMI
Date	4/14/2021, 9:05:58 AM	*File Name*	Section R-R.slmd



Material Name	Color	Unit Weight (lbs/ ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
New Fill		130	135	Mohr-Coulomb	150	30	None	0
Residual CL		125	130	Mohr-Coulomb	100	28	None	0
Weathered Sandstone		135	140	Mohr-Coulomb	150	34	None	0
Bedrock		150	150	Mohr-Coulomb	3000	40	None	0
Rock Toe		115	115	Mohr-Coulomb	0	38	None	0

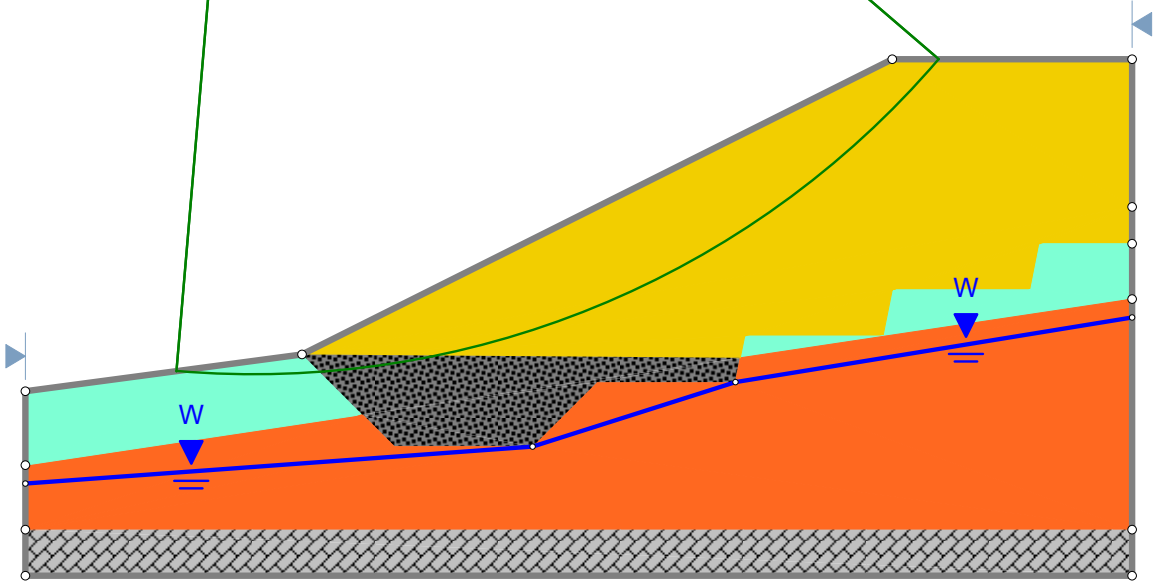
rocscience

SLIDEINTERPRET 9.012

Project	21016 - Meadows Landing Residential Development		
Group	Section B-B Fill Embankment	*Scenario*	Master Scenario
Drawn By	RJK	*Company*	GMI
Date	4/29/2021, 8:27:29 AM	*File Name*	Section B-B.slmd

1.680

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
New Fill		130	135	Mohr-Coulomb	150	30	Water Surface	Custom	1
Colluvial CL/ SC		120	125	Mohr-Coulomb	0	23	Water Surface	Custom	1
Decomposed Shale		130	135	Mohr-Coulomb	100	32	Water Surface	Custom	1
Bedrock		150	150	Mohr-Coulomb	3000	40	Water Surface	Custom	1
Rock Toe		115	115	Mohr-Coulomb	0	38	Water Surface	Custom	1



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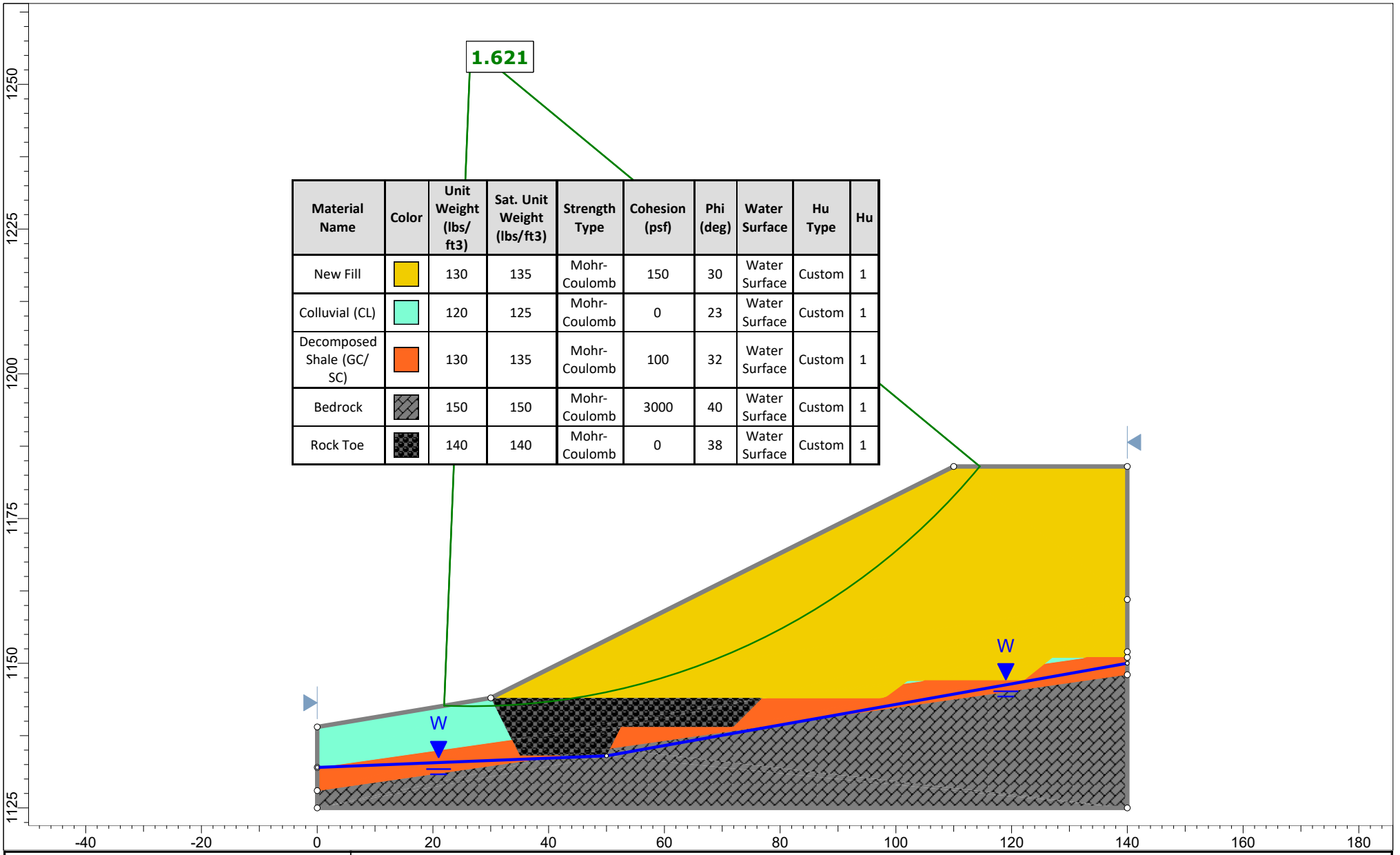
SLIDEINTERPRET 9.012

Project	21016 - Meadows Landing Residential Development		
Group	Section I-I Fill Embankment	Scenario	Master Scenario
Drawn By	RJK	Company	GMI
Date	5/11/2021, 9:16:41 AM	File Name	Section I-I.slmd

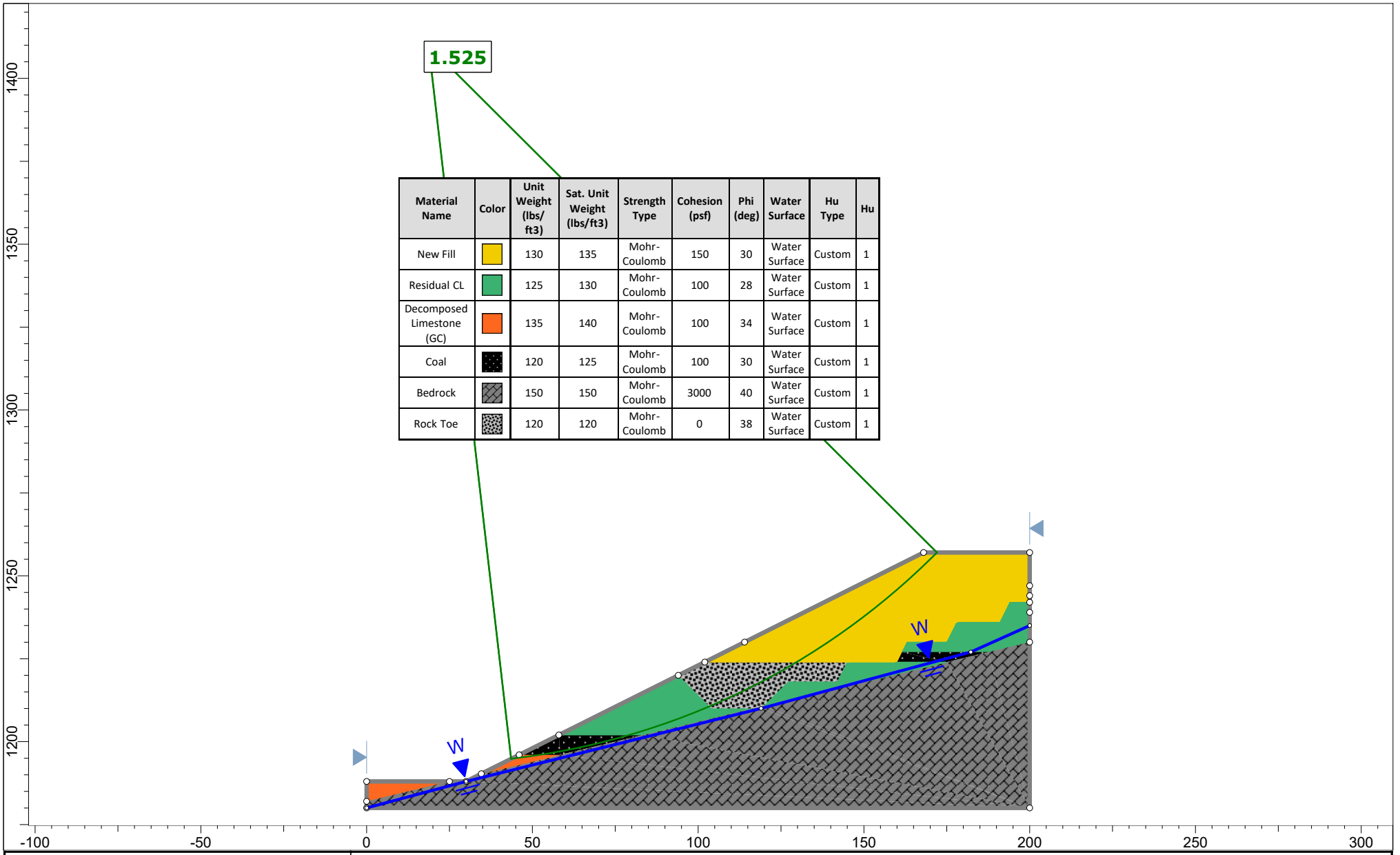


Material Name	Color	Unit Weight (lbs/ ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
New Fill		130	135	Mohr-Coulomb	150	30	Water Surface	Custom	1
Colluvial (CL)		120	125	Mohr-Coulomb	0	23	Water Surface	Custom	1
Decomposed Shale (GC/ SC)		130	135	Mohr-Coulomb	100	32	Water Surface	Custom	1
Bedrock		150	150	Mohr-Coulomb	3000	40	Water Surface	Custom	1
Rock Toe		140	140	Mohr-Coulomb	0	38	Water Surface	Custom	1

rocscience

SLIDEINTERPRET 9.012

Project	21016 - Meadows Landing		
Group	Section J-JFill Embankment	*Scenario*	Master Scenario
Drawn By	RJK	*Company*	GMI
Date	4/13/2021, 8:34:44 AM	*File Name*	Section J-J.slmd



Material Name	Color	Unit Weight (lbs/ ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
New Fill		130	135	Mohr-Coulomb	150	30	Water Surface	Custom	1
Residual CL		125	130	Mohr-Coulomb	100	28	Water Surface	Custom	1
Decomposed Limestone (GC)		135	140	Mohr-Coulomb	100	34	Water Surface	Custom	1
Coal		120	125	Mohr-Coulomb	100	30	Water Surface	Custom	1
Bedrock		150	150	Mohr-Coulomb	3000	40	Water Surface	Custom	1
Rock Toe		120	120	Mohr-Coulomb	0	38	Water Surface	Custom	1

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SLIDEINTERPRET 9.012

Project	21016 - Meadows Landing Residential Development		
Group	Section L-L Fill Over Cut	*Scenario*	Master Scenario
Drawn By	RJK	*Company*	GMI
Date	4/29/2021, 11:43:28 AM	*File Name*	Section L-L.slmd

APPENDIX E
Typical Embankment Subgrade Treatment Cross-Sections

LEGEND

P– INFILTRATION BORING

GB– PREVIOUSLY DRILLED BORING (GMI PROJECT NO. 12022)

B– PREVIOUSLY DRILLED BORING (ACA 2011)

B– PREVIOUSLY DRILLED BORING (ACA 2006)

TB– PREVIOUSLY DRILLED BORING (GMI PROJECT NO. 08068)

TB– PROPOSED BORINGS (2021)

TEST BORING LOCATION PLAN

0 120 240

SCALE IN FEET

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TOWNSHIP, WASHINGTON COUNTY, PA

SUBGRADE TREATMENT TEST BORING LOCATION PLAN

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	1 of 13

GeoMechanics, inc
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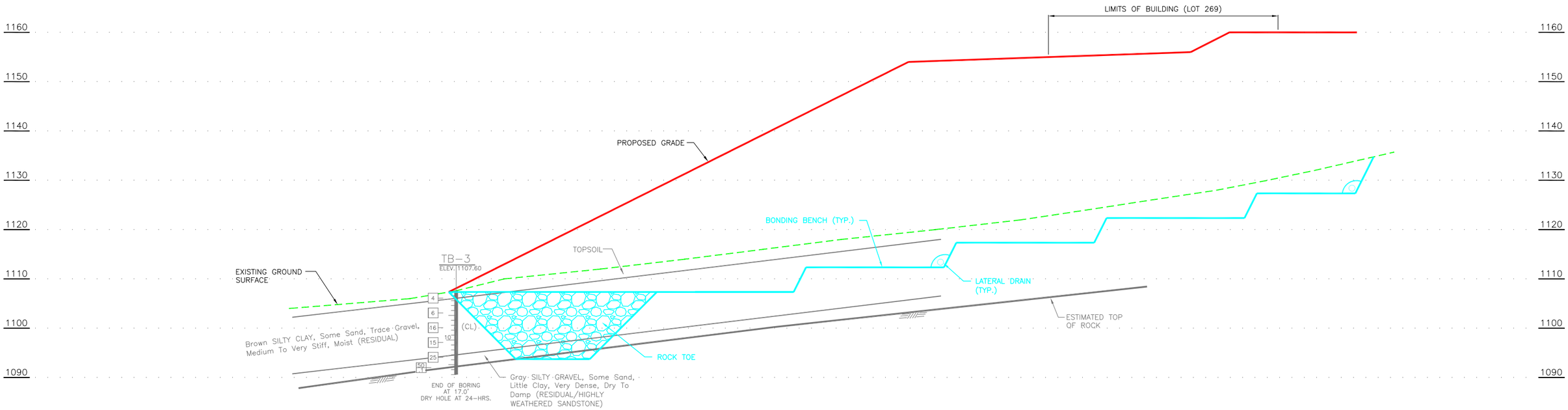
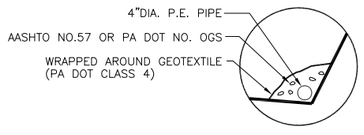
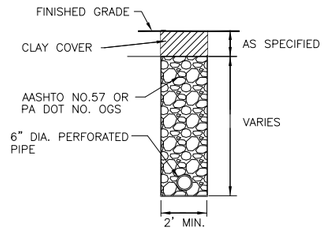


CROSS SECTION CS-1

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET



TYPICAL DETAIL SECTION OF LATERAL DRAIN



TYPICAL SECTION OF DRAINAGE TRENCH

MEADOWS LANDING RESIDENTIAL DEVELOPMENT
SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

SUBGRADE TREATMENT CROSS SECTION CS-1

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
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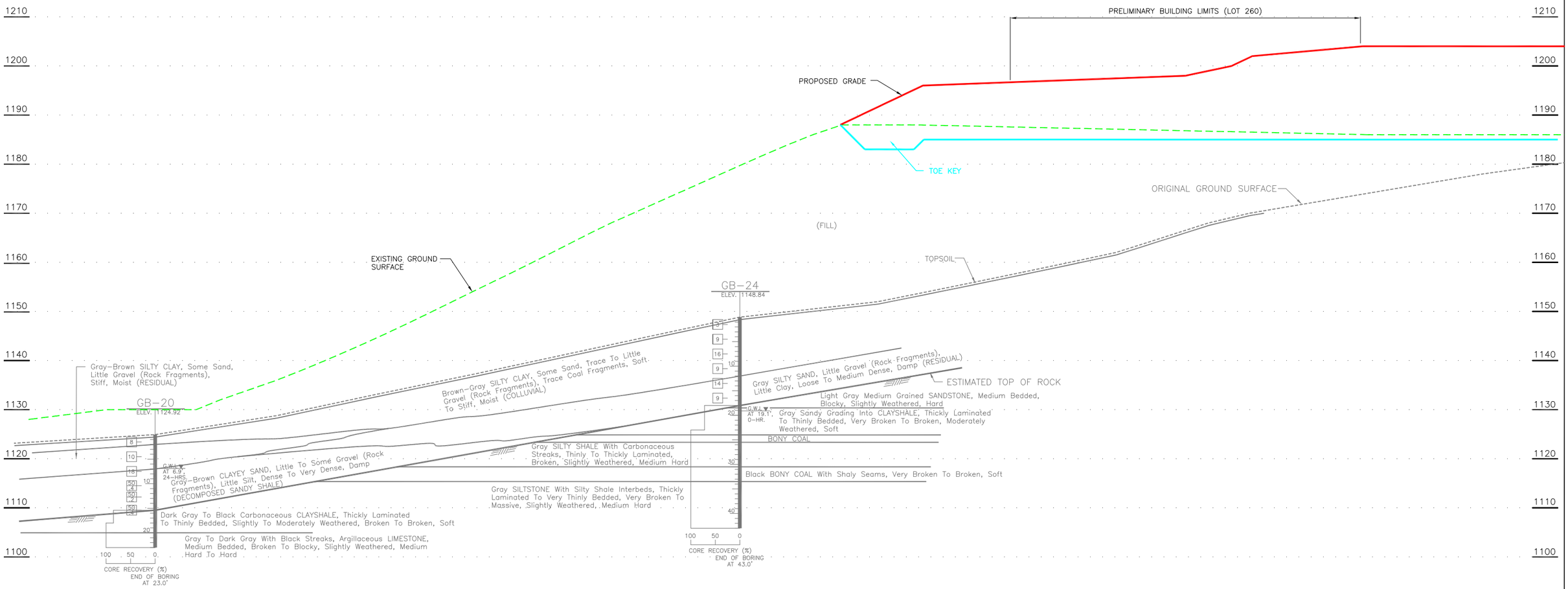
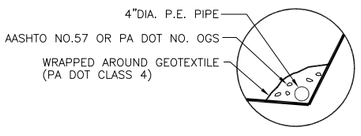
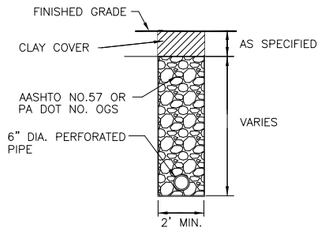


CROSS SECTION CS-2

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET



TYPICAL DETAIL SECTION OF LATERAL DRAIN



TYPICAL SECTION OF DRAINAGE TRENCH

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

SUBGRADE TREATMENT CROSS SECTION CS-2

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	3 of 13

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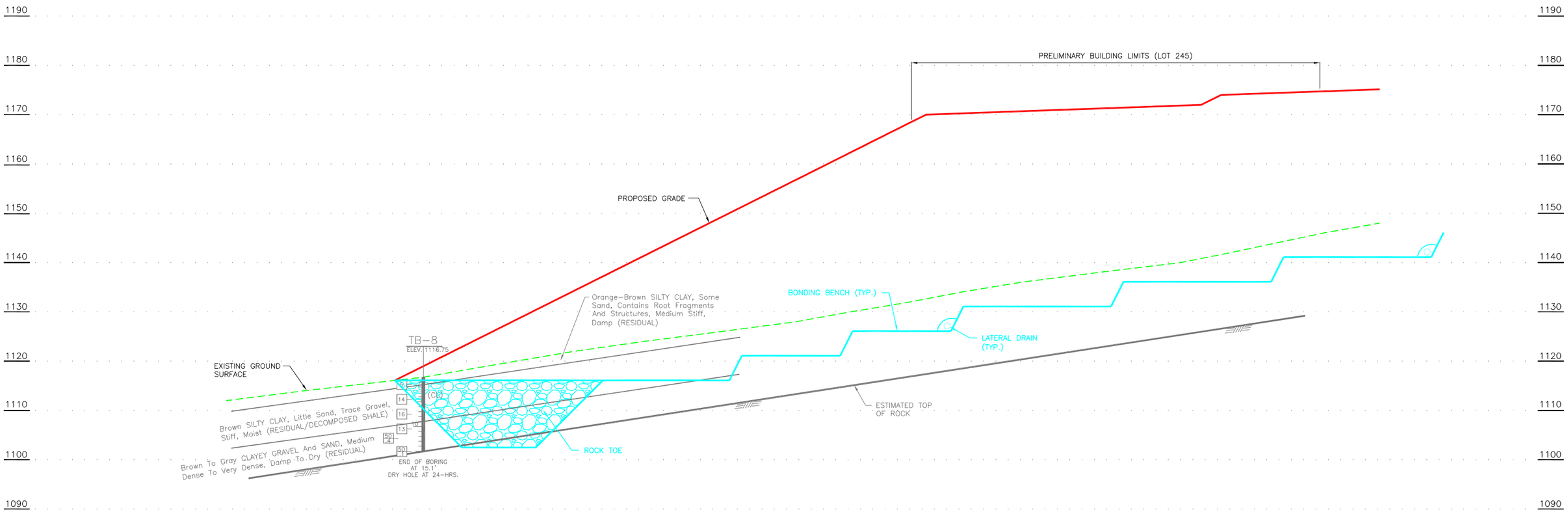
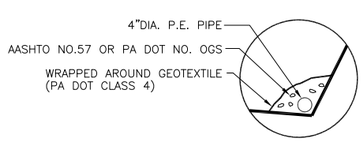
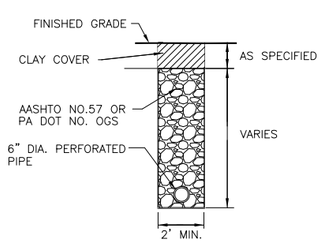


CROSS SECTION CS-3

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET



TYPICAL DETAIL SECTION OF LATERAL DRAIN



TYPICAL SECTION OF DRAINAGE TRENCH

MEADOWS LANDING RESIDENTIAL DEVELOPMENT
SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

SUBGRADE TREATMENT CROSS SECTION CS-3

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	4 of 13

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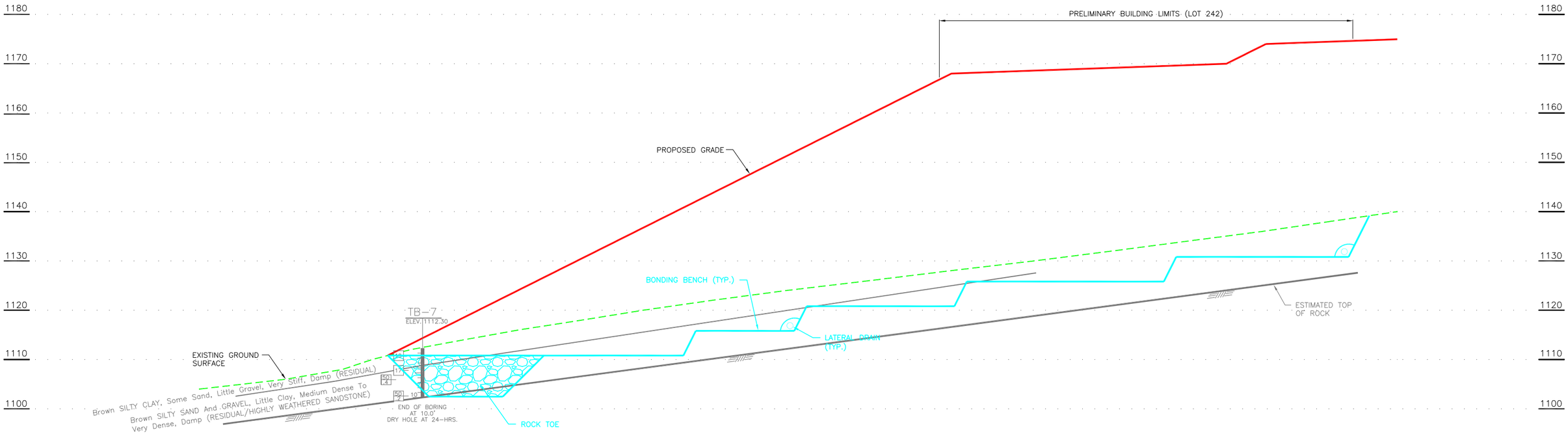
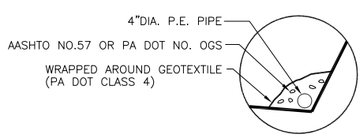
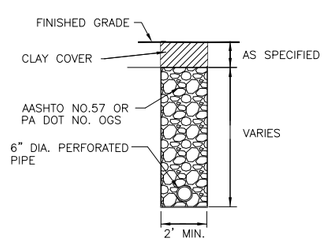


CROSS SECTION CS-4

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET



TYPICAL DETAIL SECTION OF LATERAL DRAIN



TYPICAL SECTION OF DRAINAGE TRENCH

MEADOWS LANDING RESIDENTIAL DEVELOPMENT
SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

SUBGRADE TREATMENT CROSS SECTION CS-4

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	5 of 13

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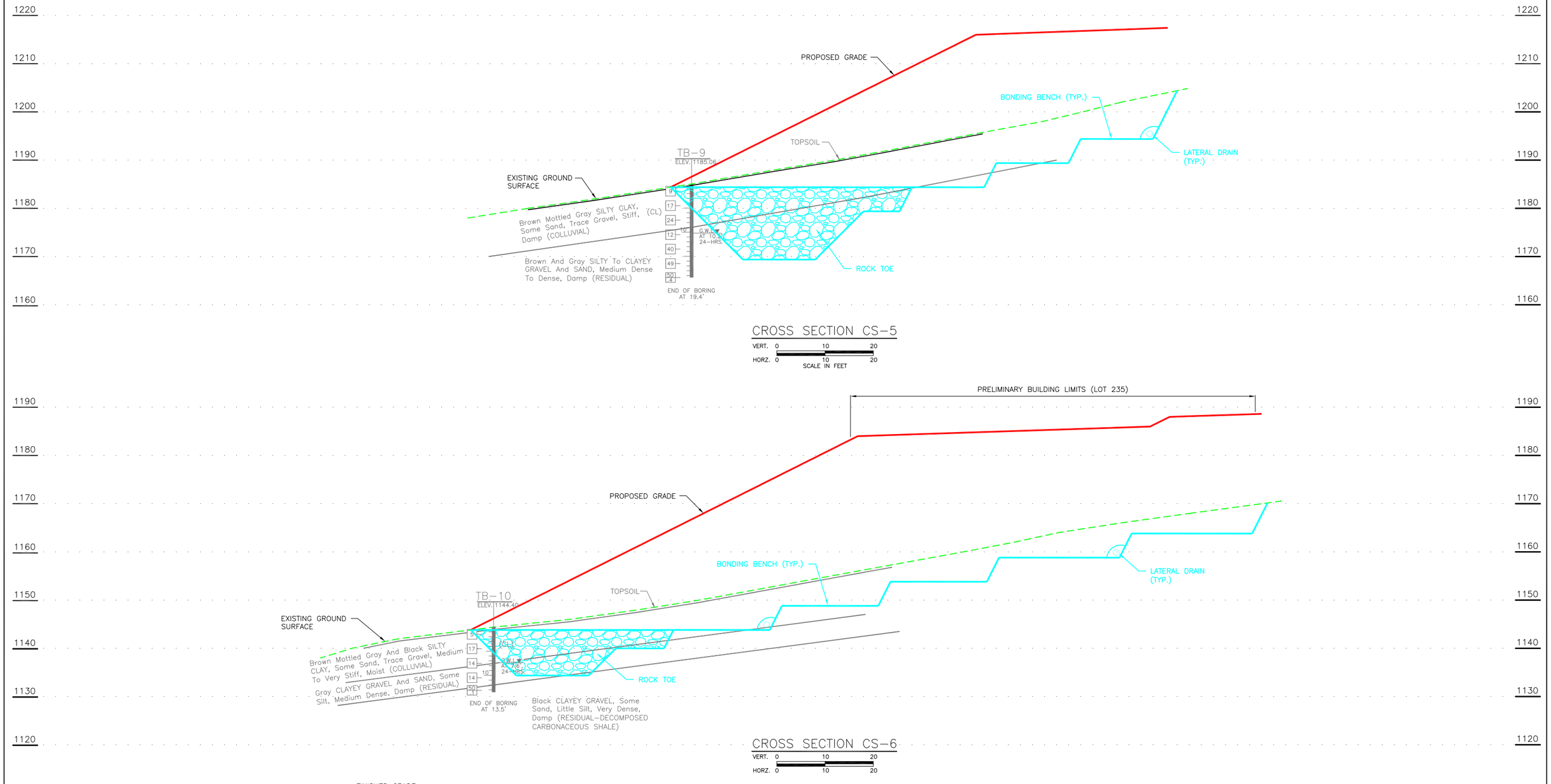
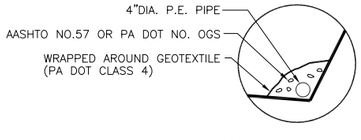


CROSS SECTION CS-5

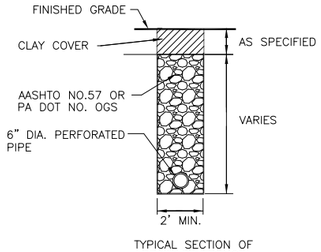
VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET

CROSS SECTION CS-6

VERT. 0 10 20
HORZ. 0 10 20



TYPICAL DETAIL SECTION OF LATERAL DRAIN



TYPICAL SECTION OF DRAINAGE TRENCH

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

SUBGRADE TREATMENT CROSS SECTIONS CS-5 AND CS-6

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	6 of 13

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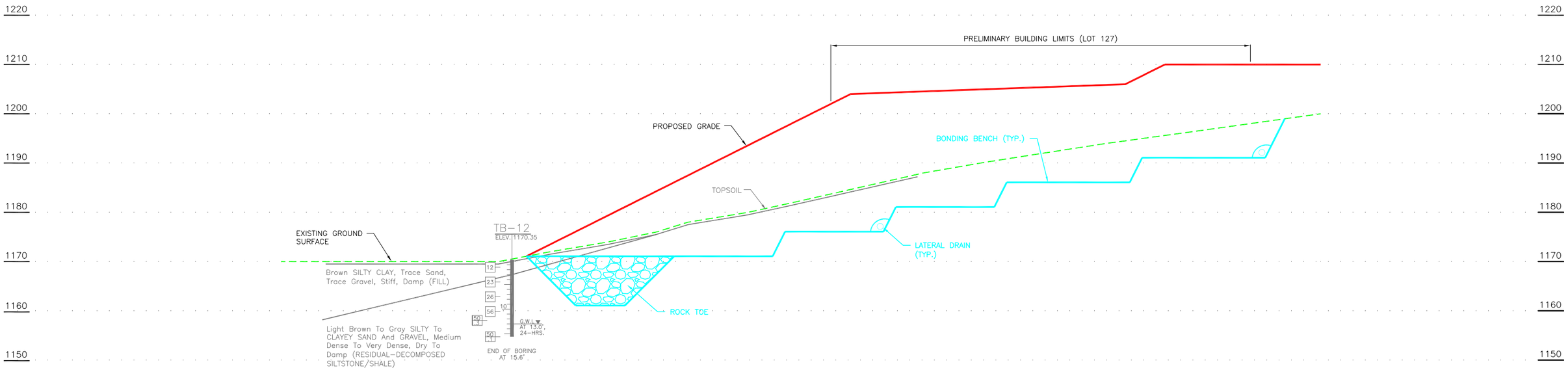
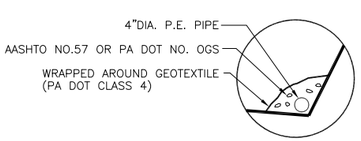
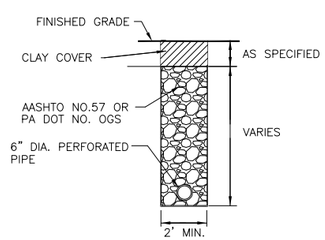


CROSS SECTION CS-7

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET



TYPICAL DETAIL SECTION OF LATERAL DRAIN



TYPICAL SECTION OF DRAINAGE TRENCH

MEADOWS LANDING RESIDENTIAL DEVELOPMENT
SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

SUBGRADE TREATMENT CROSS SECTION CS-7

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	7 of 13

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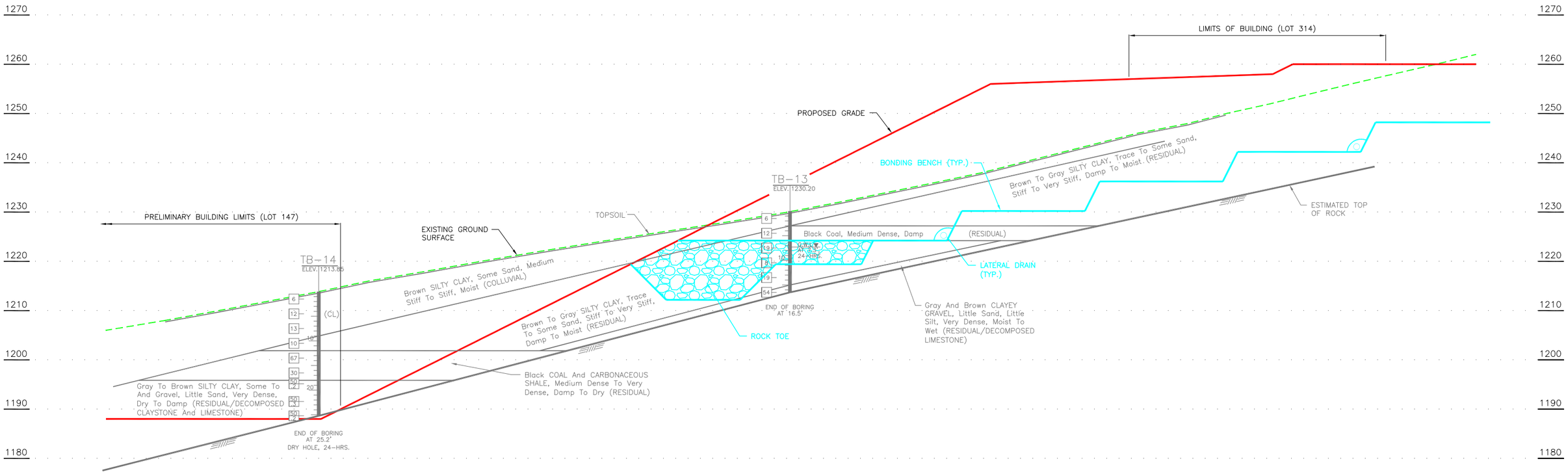
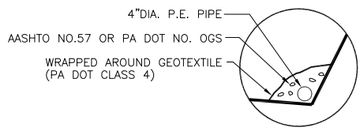
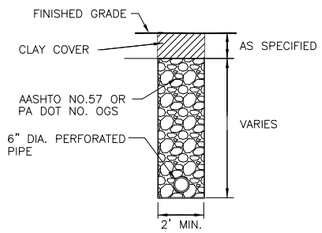


CROSS SECTION CS-8

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET



TYPICAL DETAIL SECTION OF LATERAL DRAIN



TYPICAL SECTION OF DRAINAGE TRENCH

MEADOWS LANDING RESIDENTIAL DEVELOPMENT
SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

SUBGRADE TREATMENT CROSS SECTION CS-8

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	8 of 13

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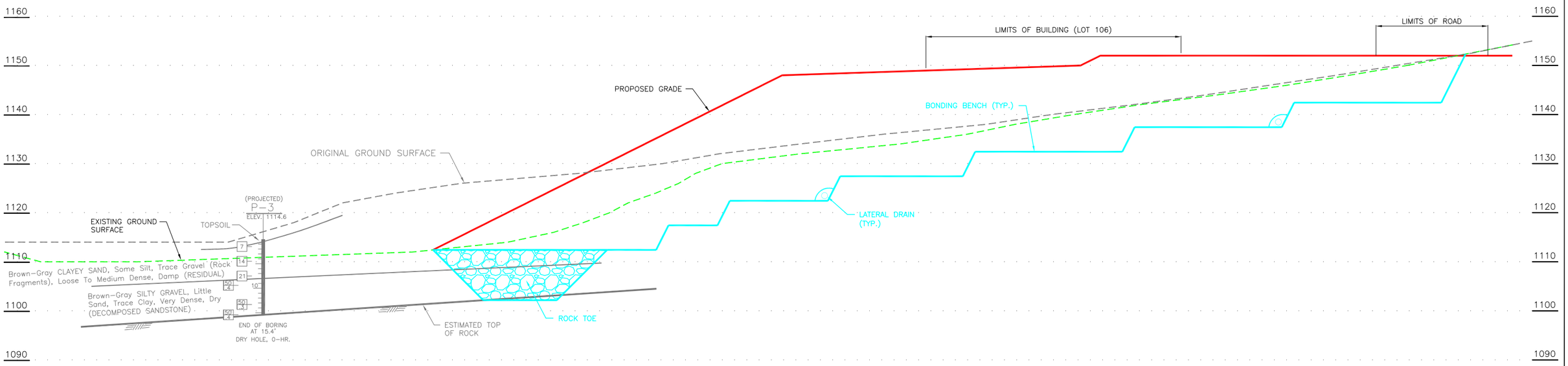
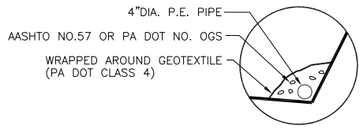
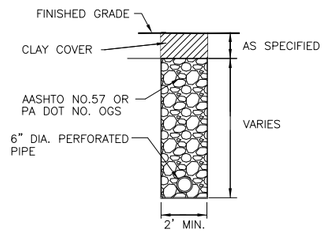


CROSS SECTION CS-9

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET



TYPICAL DETAIL SECTION
OF LATERAL DRAIN



TYPICAL SECTION OF
DRAINAGE TRENCH

MEADOWS LANDING RESIDENTIAL DEVELOPMENT
SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

SUBGRADE TREATMENT CROSS SECTION CS-9

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	9 of 13

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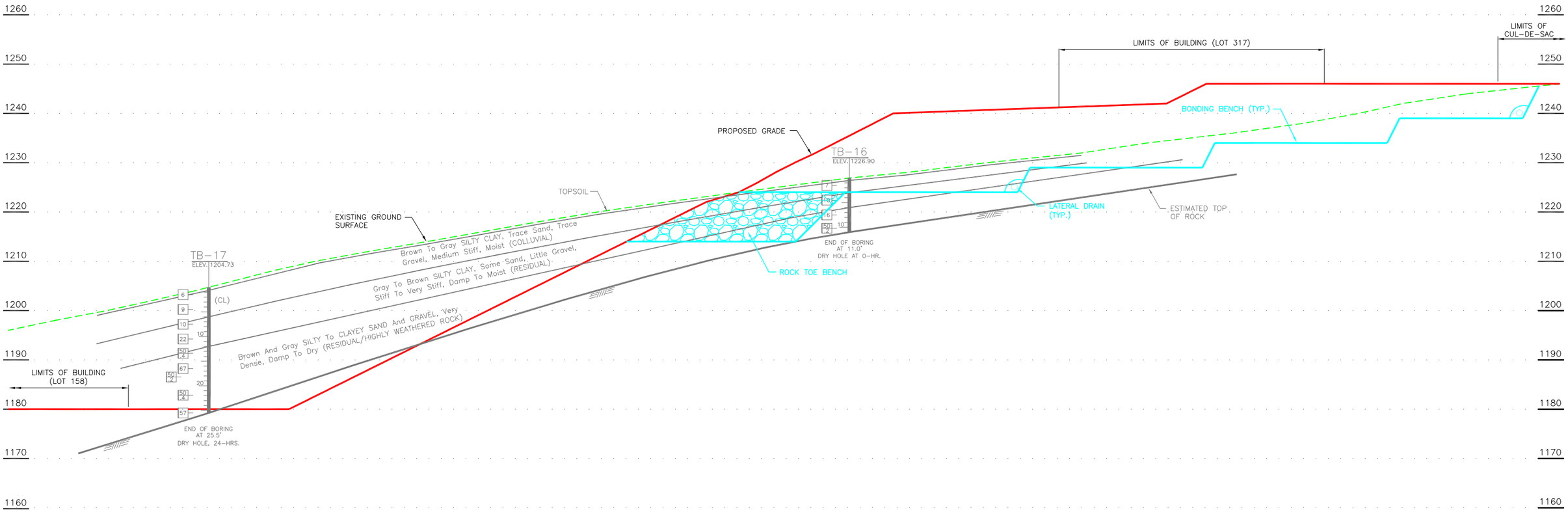
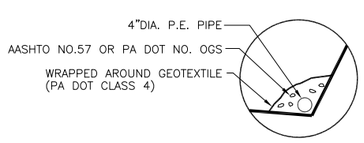
E-Mail: gmi@geo-mechanics.com

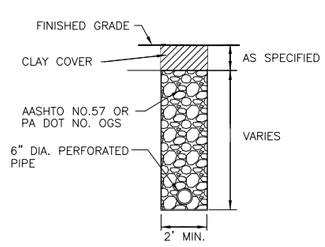


CROSS SECTION CS-10

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET



TYPICAL DETAIL SECTION OF LATERAL DRAIN



TYPICAL SECTION OF DRAINAGE TRENCH

MEADOWS LANDING RESIDENTIAL DEVELOPMENT
SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

SUBGRADE TREATMENT CROSS SECTION CS-10

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	10 of 13

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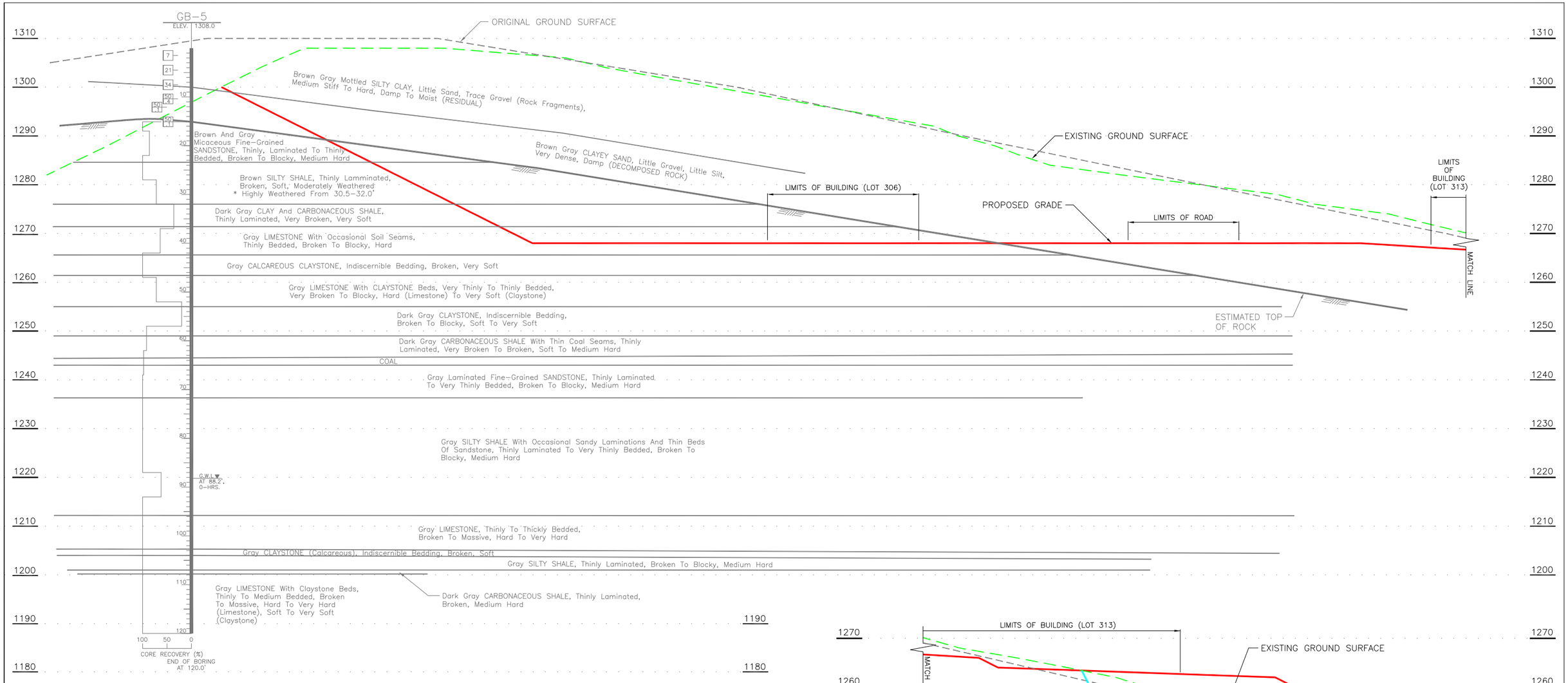
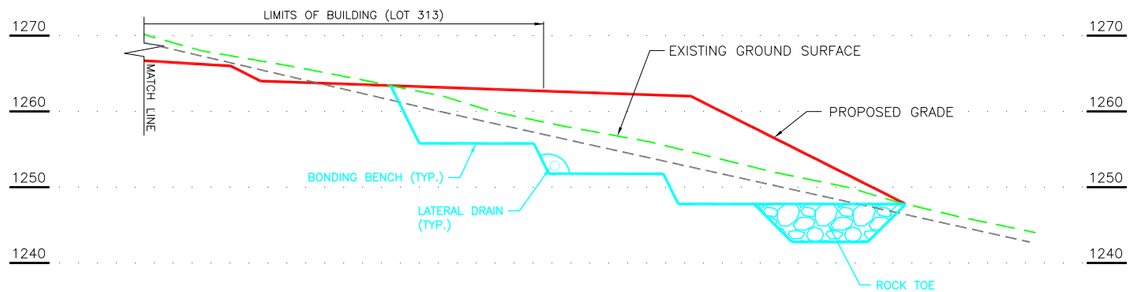
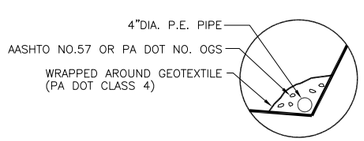


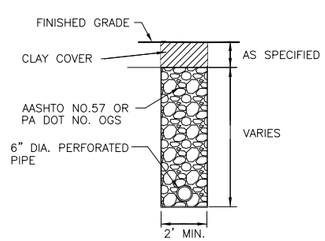
CROSS SECTION CS-11

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET





TYPICAL DETAIL SECTION OF LATERAL DRAIN



TYPICAL SECTION OF DRAINAGE TRENCH

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

SUBGRADE TREATMENT CROSS SECTION CS-11

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	11 of 13

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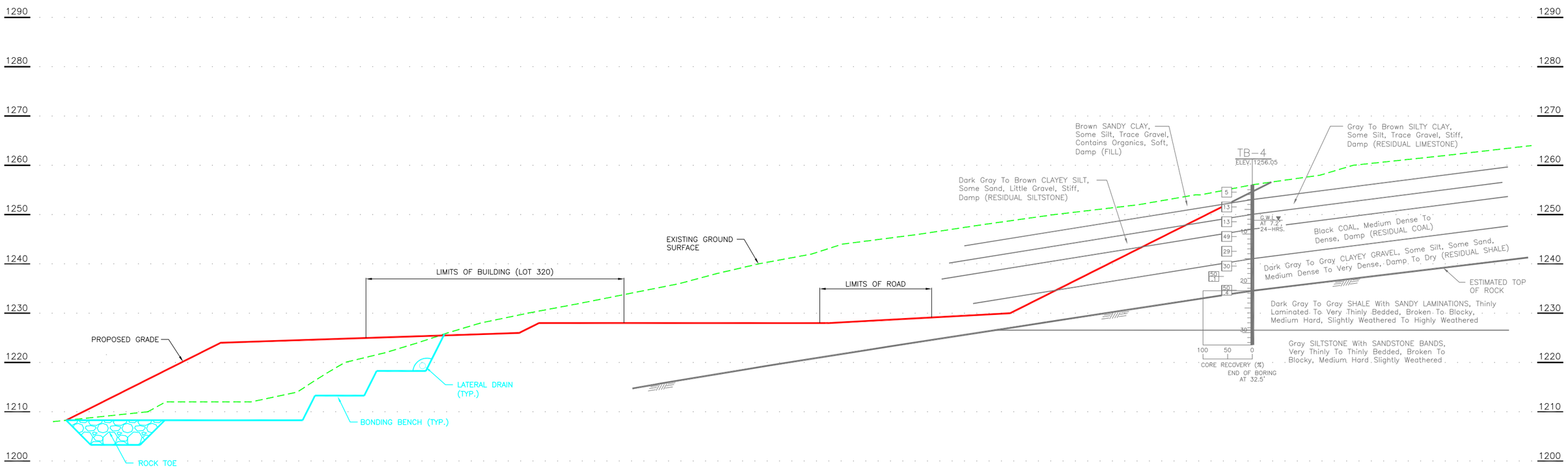
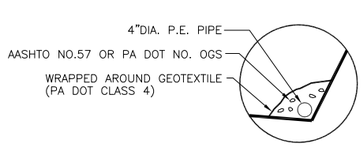
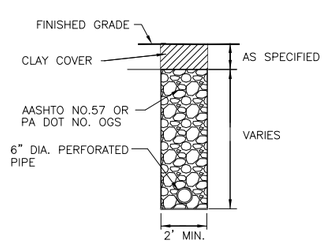


CROSS SECTION CS-12

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET



TYPICAL DETAIL SECTION OF LATERAL DRAIN



TYPICAL SECTION OF DRAINAGE TRENCH

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

SUBGRADE TREATMENT CROSS SECTION CS-12

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
	MAY 2021	AS SHOWN	M.E.H.	J.M.A.	21016	12 of 13

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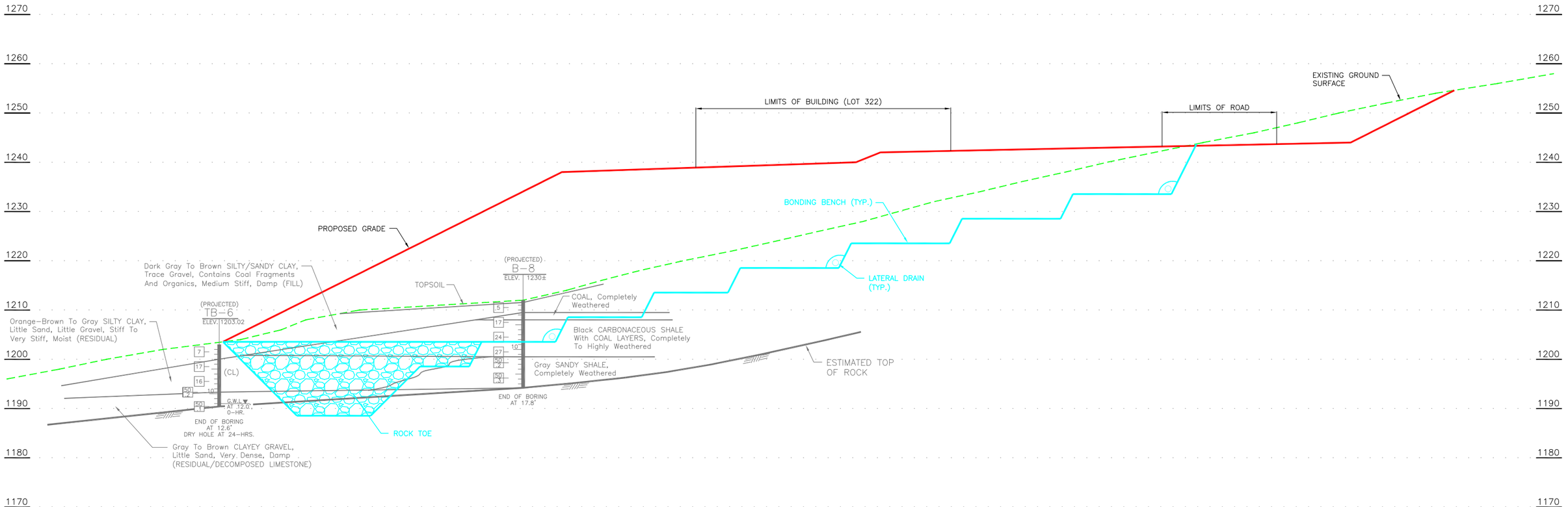
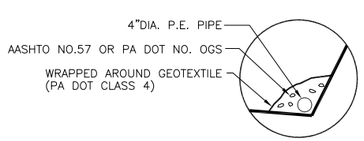
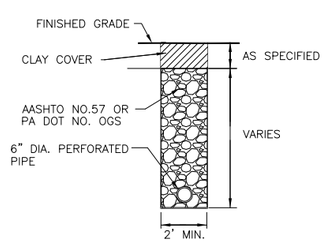


CROSS SECTION CS-13

VERT. 0 10 20
HORZ. 0 10 20
SCALE IN FEET



TYPICAL DETAIL SECTION OF LATERAL DRAIN



TYPICAL SECTION OF DRAINAGE TRENCH

MEADOWS LANDING RESIDENTIAL DEVELOPMENT
SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

SUBGRADE TREATMENT CROSS SECTION CS-13

Revision No.	Date	Scale	Drawn By	Checked By	Project No.	Sheet No.
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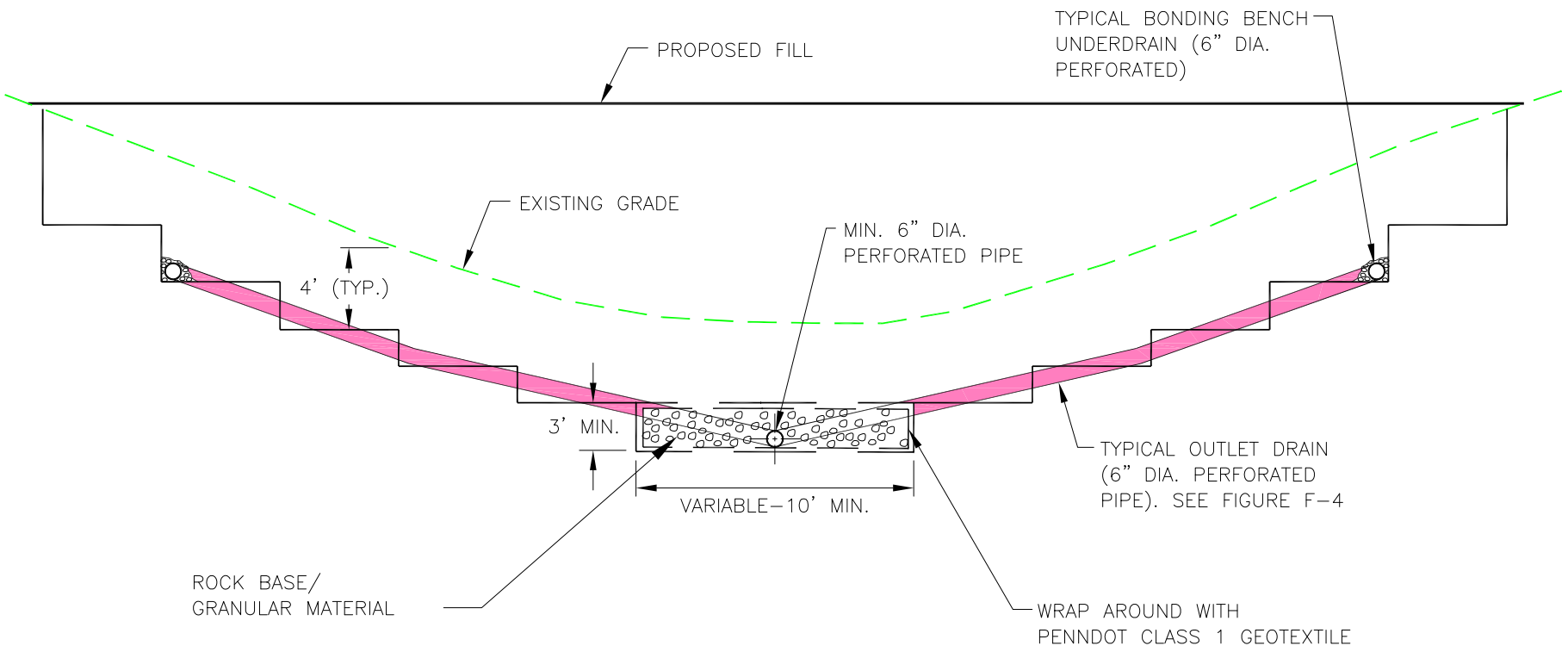
APPENDIX F
Typical Details



TYPICAL DETAILS OF VALLEY DRAIN AND UNDERDRAIN

Date:	May 2021
Scale:	None
Drn. By:	M.E.H.
Chk. By:	J.M.A.
Project No.	21016

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

SOUTH STRABANE TWP., WASHINGTON COUNTY, PA

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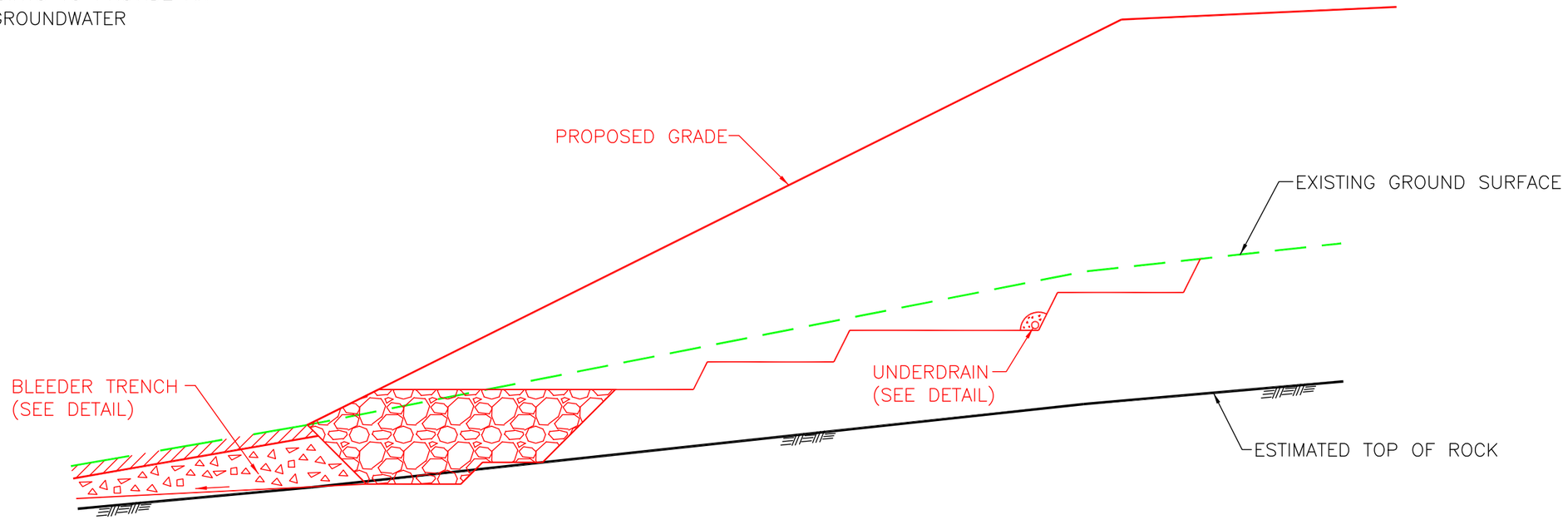
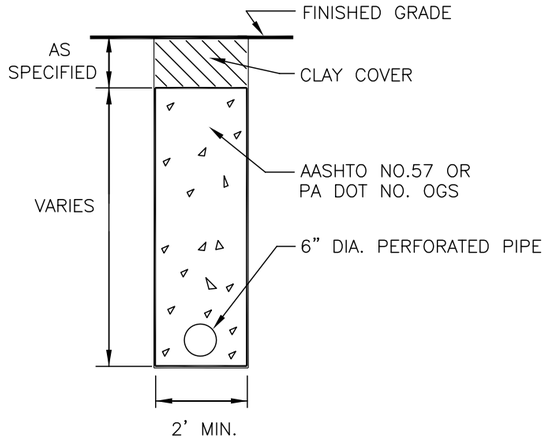
DETAIL 1

NOTE:

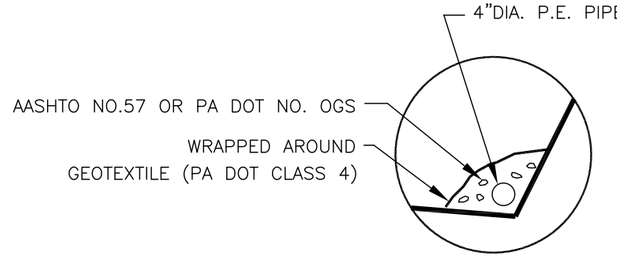
1. PROVIDE BLEEDER TRENCH EVERY 300± FEET AND/OR AT LOW POINTS TO PROVIDE AN OUTLET FOR THE. GROUNDWATER





TYPICAL SECTION OF BLEEDER TRENCH

TYPICAL BLEEDER TRENCH AND UNDERDRAIN DETAIL



TYPICAL DETAIL SECTION OF UNDERDRAIN

Date:	May 2021
Scale:	None
Drn. By:	M.E.H.
Chk. By:	J.M.A.
Project No.	21016

MEADOWS LANDING RESIDENTIAL DEVELOPMENT

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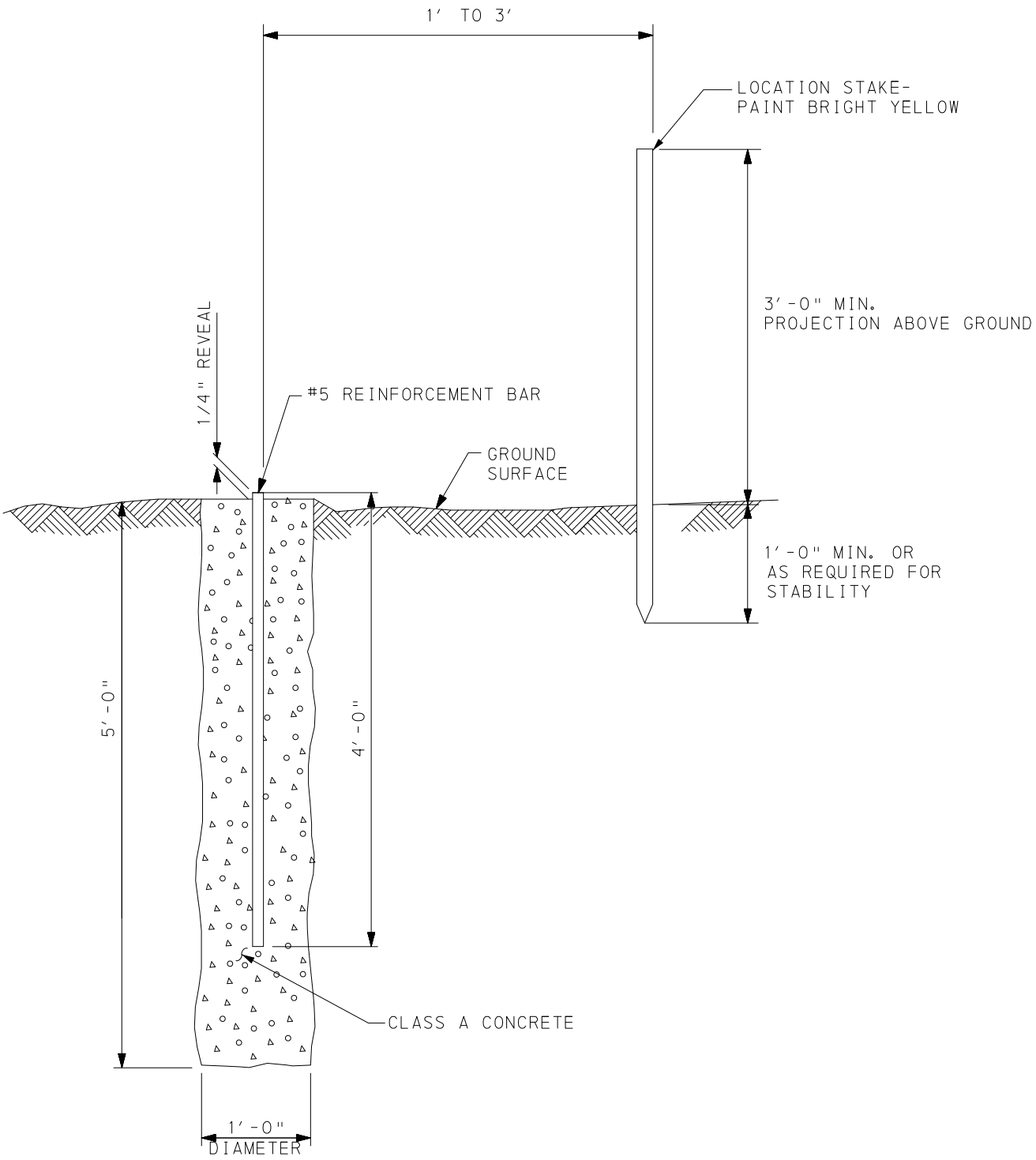
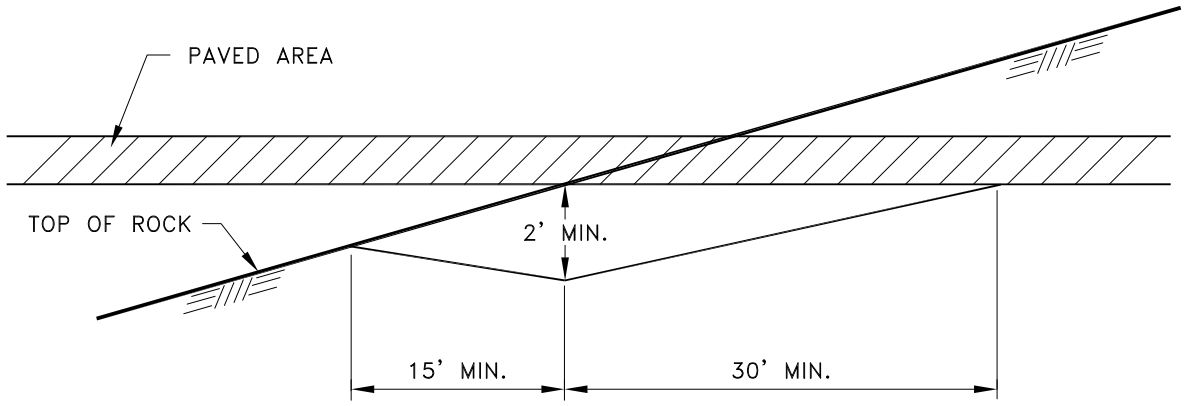
DETAIL 2



SURFACE MONUMENT DETAIL

Date: May 2021	MEADOWS LANDING RESIDENTIAL DEVELOPMENT	DETAIL 3
Scale: None	SOUTH STRABANE TWP., WASHINGTON COUNTY, PA	
Drn. By: M.E.H.	GeoMechanics, inc Consulting Engineers / Scientists	600 Munir Drive, P.O. Box 386 Elizabeth, PA 15037-0386 Phone: (724) 379-6300 Fax: (724) 379-4242 E-Mail: gmi@geo-mechanics.com
Chk. By: J.M.A.		
Project No. 21016		



TYPICAL DETAILS:
SOIL–BEDROCK TRANSITION BENCH UNDER PAVED AREAS

Date: May 2021	MEADOWS LANDING RESIDENTIAL DEVELOPMENT		DETAIL 4
Scale: None	SOUTH STRABANE TWP., WASHINGTON COUNTY, PA		
Drn. By: M.E.H.	GeoMechanics, inc Consulting Engineers / Scientists	600 Munir Drive, P.O. Box 386 Elizabeth, PA 15037–0386 Phone: (724) 379–6300 Fax: (724) 379–4242 E–Mail: gmi@geo–mechanics.com	
Chk. By: J.M.A.			
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