

Report of:

**Subsurface Investigation (Roadway) For
Underpass of CSX Railroad Connecting
Commerce Parkway and KY 146
Oldham County, Kentucky
Item #5-434.00**

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DLZ Job No. 0631-0006.02

September 4, 2015

Prepared for:
**Oldham County Fiscal Court
100 West Jefferson Street
La Grange, Kentucky 40031**



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OF
SUBSURFACE EXPLORATION (ROADWAY ONLY)
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EXECUTIVE SUMMARY

This summary should be used in conjunction with the entire report for design purposes. It should be noted that details of the subsurface exploration are not presented in this summary section and that the report must be read in its entirety for a comprehensive understanding of the items contained herein. The following solely provides a brief description of the project and a brief summary of our findings and recommendations.

The proposed project consists primarily of lowering the existing Allen Lane at the CSX railroad crossing, and relocating the existing Allen Lane slightly to the west in order to provide a grade separation at the Allen Lane/CSX railroad intersection. As part of the proposed work, a new CSX bridge will be constructed over the lowered Allen Lane, and a temporary railroad diversion track (railroad runaround) will be installed north of the existing track in order to maintain railroad traffic during the Allen Lane/CSX railroad construction.

A field exploration consisting of drilling forty borings and installing five observation wells was performed to determine the subsurface conditions at the proposed work locations. The borings were drilled to depths of between 2.4 and 34 feet below the existing ground surface. Rock soundings and rock coring were performed at selected boring locations. In general, the existing overburden soils consisted primarily of low to high plasticity clays to the top of bedrock at depths varying from 0.5 to 13 feet. The overburden soils in the areas south of the existing railroad tracks and along Commerce Parkway were primarily low plasticity clays (lean clays) with isolated high plasticity clays (fat clays); however, the overburden soils in the northern one-third of the proposed Allen Lane alignment, near the existing railroad track, were primarily fat clays (AASHTO A-7-5 or A-7-6). Groundwater levels were encountered in isolated areas at depths of between 2.7 and 10.9 feet or at elevations between 783 and 850.7 feet.

Stability analyses and settlement evaluations were performed for the critical sections with the anticipated maximum amount of new fill and the anticipated largest amount of grade cut in order to establish the maximum steepness of the side slope of the new embankment and the cut section. The most critical section was generally considered to be the section constructed in the thickest layers of cohesive soils. The groundwater level was assumed to be 2 feet above the soil-rock interface in the analyses, and a vertical live load railroad surcharge of 1,880 psf (8'-6" wide continuous strip) was used in the cut and fill sections at the railroad crossing in the stability analyses for the short-term (undrained shear strength) condition only. Based on the results of the analyses for the critical sections identified, the side slopes along the proposed roadway are recommended and summarized in the following tables.

Table 1. Allen Lane (between Sta. 137+75 and approximate Sta. 168+00)

	Anticipated Maximum Amount of Cut/Fill, ft (Approximate Station Analyzed)	Recommended Side Slope
Cut	14 (Sta. 140+00)	2H:1V or flatter
Fill	7 (Between Sta. 160+50 and Sta. 166+50)*	2H:1V or flatter*

*Per discussions with KYTC, analyses were not performed because the embankment section is less than 20 feet.

Table 2. Allen Lane (between approximate Sta. 171+00 and Sta. 175+13.61) – Grade Separation Outside the Proposed Bridge Location

	Anticipated Maximum Amount of Cut, ft (Approximate Station Analyzed)	Recommended Side Slope
Cut	18 (Sta. 171+00)	3H:1V or flatter

Table 3. Commerce Parkway

	Anticipated Maximum Amount of Cut/Fill, ft	Recommended Side Slope
Cut	12	2H:1V*
Fill	Sliver Fill** of Low Heights and Thicknesses	2H:1V

*Per discussions with KYTC, results of the analyses for Allen Lane will also apply to Commerce Parkway; therefore no analyses were performed.

**Benching requiring horizontal cuts into existing slopes to provide interlock with existing soils for shear resistance shall be used in accordance with the applicable KYTC requirements.

Table 4. Temporary Railroad Diversion Track (Railroad Runaround)

	Anticipated Maximum Amount of Fill, ft (Approximate Station Analyzed)	Recommended Side Slope	Estimated Settlement, inch
Fill	10 (Sta. 1529+50)	2H:1V or flatter*	2.1

*In the stability analysis, the railroad surcharge of 1,880 psf was applied for the short-term (undrained) condition only.

A CBR design value of 2.0 is recommended provided a minimum of 2.0-foot soil subgrade will be maintained. The CBR design value of 2.0 should also be used for the material beneath the subgrade. Pavement underdrains should be provided to reduce the possibility of trapping water within the subgrade.

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1.0 LOCATION AND DESCRIPTION

The proposed project consists primarily of lowering the existing Allen Lane at the CSX railroad crossing, and relocating the existing Allen Lane slightly to the west in order to provide a grade separation at the Allen Lane/CSX railroad intersection. Allen Lane is generally aligned in a north/northwest and south/southeast orientation, intersecting Commerce Parkway at the south end and KY 146 at the north end. The existing CSX railroad generally runs east and west across Allen Lane at approximately 500 feet south of KY 146 (Hwy 146). As part of the proposed work, a new CSX bridge will be constructed over the lowered Allen Lane, and a temporary railroad diversion track (railroad runaround) will be installed north of the existing track in order to maintain railroad traffic during the Allen Lane/CSX railroad construction. The existing grade along Allen Lane between Commerce Parkway and KY 146 will also be modified. The proposed work along Allen Lane will begin at its intersection with Commerce Parkway (Sta. 137+75.11) and end at its intersection with KY 146 (Sta. 175+13.61). Based on the current design information, it is anticipated that construction of the new Allen Lane will mostly require grade cuts of up to approximately 26 feet and placement of fills of up to approximately 7 feet. The larger amounts of grade cuts (greater than 14 feet) are generally required to accommodate the proposed alignment shift to the west and the proposed grade separation at the Allen Lane/CSX railroad intersection, approximately between Sta. 168+00 and Sta. 174+00. For the construction of the railroad runaround, it is anticipated that fills of up to approximately 10 feet thick will be placed within approximately 80 to 85 feet north of the proposed bridge location.

As part of the proposed work along Allen Lane, the existing Commerce Parkway will be widened to add turn lanes, which would impact the existing bike path along the north side of Commerce Parkway. A minimal amount of road improvement, consisting primarily of some “sliver fills” of relatively low heights and thicknesses, is also planned on the south side of Commerce Parkway, within the existing right-of-way. The proposed work along Commerce Parkway will begin at approximately 250 feet west of its intersection with Allen Lane (Sta. 42+50) and end at Sta. 57+00. It is anticipated that cuts of up to approximately 12 feet in the existing embankment along the north side of Commerce Parkway will be required.

The latitude and longitude coordinates at the intersection of Allen Lane and Commerce Parkway in decimal format is 38.392575° and -85.394302°, respectively.

This report addresses the geotechnical issues for the proposed design and construction of the roadway portion and the railroad runaround. The geotechnical report for the proposed CSX railroad bridge will be prepared under separate cover.

The purpose of this exploration was to 1) explore the subsurface conditions to the depths of the borings, 2) evaluate the engineering characteristics of the subsurface materials, and 3) provide information to assist in the design and construction of the proposed roadway work. The exploration presented in this report was performed essentially in accordance with DLZ Kentucky, Inc.'s (DLZ) proposal for the project last revised on July 3, 2014.

The geotechnical engineer has planned and supervised the performance of the geotechnical engineering services, considered the findings, and prepared this report in accordance with generally accepted geotechnical engineering practices. No other warranties, either expressed or implied, are made as to the professional advice included in this report.

2.0 TOPOGRAPHY AND DRAINAGE

The project area is in the Outer Bluegrass Region of north-central Kentucky. The terrain is gently rolling to hilly. The maximum vertical relief along the centerline of the proposed Allen Lane alignment is approximately 100 feet, while the maximum vertical relief along the centerline of Commerce Parkway is approximately 7 feet. The site is situated in the Curry's Fork watershed, which is located in the Salt River Basin. Drainage from the project area flows into the North Curry's Fork, which is located approximately 1,000 feet south of the intersection of Allen Lane and Commerce Parkway. The North Curry's Fork discharges into Floyds Fork, which discharges into the Salt River, a tributary of the Ohio River.

Based on the Geologic Map of Kentucky, Oldham County is the karst prone area of the outer Bluegrass Region. However, according to Kentucky Geological Survey, the project area is located in a moderate karst potential area, and is not known for significant karst topography. However, one documented sinkhole is located approximately 300 feet east of Allen Lane and approximately 700 feet south of Artisan Parkway. Artisan Parkway is a side road near the north end of Allen Lane, approximately 600 feet south of the existing CSX railroad crossing. According to LiDAR data, three other potential sinkholes may be located in the immediate vicinity of this documented sinkhole. However, the karst topography does not reportedly play a major role in the Curry's Fork watershed or in the transport of groundwater.

According to the Geological Quadrangle Map of La Grange prepared in 1971 (GQ-901), a few ponded areas were located approximately within 500 feet to the east, northeast, and southwest sides of Allen Lane and a small stream ran north/northeast and south/southwest between the ponded areas on the southwest and northeast sides of the road. However, based on aerial imagery from Google Earth, taken on September 22, 2014, the small stream and the majority of the ponded areas indicated on the 1971 Geological Quadrangle Map of La Grange appeared to have been filled. A field reconnaissance performed on August 28 and 29, 2014 did not identify the presence of any streams in the immediate vicinity of the proposed roadway alignments or in the areas identified on the historical mapping. However, a retention pond was observed at approximately 50 feet east of existing Allen Lane and approximately 150 feet south of Artisan Parkway (approximately Sta. 161+00). This existing retention pond may be impacted if additional right-of-way is required.

3.0 GEOLOGY

The soils in the project area tend to delineate with the drainage patterns of the Curry's Fork. According to the Soil Survey of Oldham County, Kentucky, issued in November 1977, the majority of soil contained in the project area is classified primarily as clay loam with low organic content and high clay content.

According to the Geological Quadrangle Map of La Grange, the roadway alignments within the project limits are underlain by limestone, shale, and dolomite bedrock belonging to Laurel Dolomite, Osgood and Brassfield Formations of Silurian age, and Saluda Dolomite and Bardstown Members of Ordovician Age Drakes Formation, in descending order of lithology. A map showing the bedrock formation along the proposed roadway alignments is included in Appendix I. The La Grange Quadrangle Map showing the project location is also included in the appendix.

The Laurel Dolomite is described as consisting of dolomite of two types. One type of dolomite, which occurs in the upper portion of the unit, consists of greenish-gray to light-olive-gray dolomite, micro-grained to very finely crystalline-grained and weathers dark yellowish-orange. The second type is described as being more massive and somewhat porous, mottled dolomite in two bedding sets separated by dark-gray to olive-gray dolomitic clay shale situated approximately five to eight feet above the base of the formation.

The Osgood Formation is described as consisting of interbedded shale and dolomite. The shale is greenish gray to olive gray, dolomitic, and weathers yellowish gray to grayish orange. The lower part of the unit is generally more clayey than the upper part and weathers to plastic clayey mass. The dolomite at the base of the unit is medium gray to olive gray and weathers mottled yellowish gray and grayish orange. The dolomite is generally very fine-grained in even beds of 1 inch to 1 foot thick with thin shale partings.

The Brassfield Formation is described as consisting of interbedded limestone and dolomite. The limestone occurs as two types; medium- to very coarse-grained and very fine-grained. The medium- to very coarse-grained limestone is yellowish gray to yellowish brown and weathers yellowish brown. The limestone contains sparse to common large fossil fragments and whole fossils and large colorless calcite crystals. The very fine-grained limestone is yellowish gray to greenish gray, thinly laminated, and without megafossils. The dolomite of the unit occurs as both medium- to coarse-grained and very fine-grained types, and is generally calcitic. Both limestone and dolomite contain irregular patches of unidentified finely crystalline bright green minerals, very dark green grains of glauconite, and scattered pyrite crystals. The Brassfield Formation is generally a few feet thick and is not present in some small areas.

The Drakes Formation is composed of Saluda Dolomite Member, Bardstown Member, and Rowland Member, in descending order of lithology. The Drakes Formation is described as consisting of interbedded dolomite, limestone, mudstone, and shale. Dolomite, dolomitic limestone, and mudstone are most abundant and are commonly composed of silt-sized grains, are sparsely fossiliferous or unfossiliferous, partly laminated, and locally mud cracked and ripple marked. The Bardstown Member, which makes up only a small part of the total Drakes, is

composed of fossiliferous limestone in irregular or nodular beds thinly interbedded with fossiliferous or sparsely fossiliferous shale. The Drakes Formation generally ranges in thickness from 20 to 150 ft.

No faults or other detrimental geologic features are noted to be present by the referenced mapping within the immediate vicinity of the existing and proposed roadway alignments.

In Oldham County, water is obtained from consolidated sedimentary rocks of Ordovician, Silurian, and Devonian ages, and from unconsolidated sediments of Quaternary age. The unconsolidated Quaternary sediments have primarily been deposited along the larger streams and rivers like the North Curry's Fork located approximately 1,000 feet to the south of the intersection of Allen Lane and Commerce Parkway. Wells installed in smaller creek valleys and some broad ridges in western and central Oldham County generally can produce enough water for a domestic supply, except during dry weather. However, in upland areas of the rest of Oldham County, where the project is located, most drilled wells generally cannot produce enough water for a dependable domestic supply, unless the wells are drilled along drainage lines or in areas where thick limestone is present, in which cases wells may produce up to 100 to 500 gallons per day, except during dry weather.

4.0 FIELD EXPLORATION

4.1 Summary

DLZ prepared the scope of field exploration based on the proposed work of the project. The field exploration plan was reviewed and subsequently approved by the Kentucky Transportation Cabinet (KYTC) Geotechnical Branch.

The field exploration originally consisted of drilling forty-four borings (B-1, B-2, B-3a, B-3b through B-43) and installing four observation wells at borings B-1, B-2, B-3a, and B-3b. It should be noted that borings B-28 through B-43 were drilled for the proposed railroad bridge. Because of site constraints, borings B-29, B-33, B-38, and B-42 were eliminated from the boring program during the field exploration. Boring B-1 was located approximately 150 feet south of boring B-2, while boring B-3a was approximately 50 feet west of boring B-3b. The depths to top of bedrock at borings B-1 and B-2 were approximately 5 and 8.5 feet below the existing ground surface, respectively, and the depths to top of bedrock at borings B-3a and B-3b were both at approximately 5 feet. Given the relatively close proximity of boring B-1 to boring B-2, the close proximity of boring B-3a to B-3b, the shallow depths to top of bedrock at these boring locations, the locations of the observation wells were modified to monitor the long-term groundwater levels in more widespread area, including the proposed bridge location. As approved by KYTC, observation wells were installed near borings B-2, B-3b, B-32, and B-41. During the field exploration, an additional observation well was installed near boring B-22 to monitor the long-term groundwater levels in the proposed railroad runaround area. The majority of the borings were drilled between September 2 and 10, 2014, except for borings B-1, B-20, B-21, and B-22, which were drilled on December 29 and 30, 2014 due to property access constraints. The five observation wells were also installed on

December 29 and 30, 2014. The borings were drilled using either a truck-mounted or an all-terrain-vehicle (ATV) mounted rotary-type drill rig with automatic hammers.

In order to avoid existing underground utilities, existing site features and/or for accessibility, the as-drilled locations of some of the borings were field offset from the originally planned locations. A sketch showing the as-drilled boring locations with respect to the existing features is presented in Appendix I. The stations and offsets and latitude and longitudes of the as-drilled boring locations are on the boring logs in Appendix I. The locations and elevations of the borings were determined in the field by representatives of DLZ. All drilling and sampling were performed in general accordance with the current KYTC Geotechnical Manual, Section GT-300. Information concerning the general drilling procedures is presented in Appendix I.

The present field investigation was undertaken to develop engineering information to meet the purposes as described in Section 1, "Location and Description," of this report. The intent of these services was not to uncover or identify any contaminated subsurface material that may contain hazardous or flammable substances. Identification of such substances requires specialized exploration techniques and analyses that were not employed in this investigation.

A field log was prepared for each boring. These logs contain visual classifications of the materials encountered during drilling as well as an interpolation of the subsurface conditions between samples. Final logs, included in Appendix I, represent our interpretation of the field logs and may include modifications based on laboratory observations and tests of the field samples. The final logs describe the materials encountered, their thicknesses, and the locations where samples were obtained. Ground surface elevations at the borings are presented on the final logs.

4.1.1 Rock Coring Borings

Rock cores were obtained in borings B-1 and B-2. The Standard Penetration Tests were performed generally in 1.5-foot increments at intervals not exceeding 5 feet through the overburden to the top of bedrock. Rock cores were obtained to the originally planned elevations; NQ size diamond coring tools were used with water as the circulating fluid. Borings B-1 and B-2 were drilled to depths of 23 and 34 feet, respectively. Upon completion of the borings, the soil samples and the rock cores were transported to DLZ's office and logged by the project geologist. The geologist determined the depth of the rock disintegration zone (RDZ) for each boring, and also determined the percent recovery and rock quality designation (RQD) for each core run.

4.1.2 Rockline Soundings

Rockline soundings were performed in borings B-4 through B-7 by drilling through the overburden to top of bedrock. Upon auger refusal on bedrock, the Standard Penetration Test was performed at the refusal depth to obtain a bedrock

sample for visual classification. Borings B-4 through B-7 were drilled to depths of between 7.3 and 9.4 feet.

4.1.3 Disturbed Soil Borings

Disturbed soil borings were performed in borings B-8 through B-21 by drilling to the top of bedrock or the originally planned elevations, whichever occurred first. If auger refusal occurred first, a Standard Penetration Test was performed at the refusal depth to obtain a bedrock sample for visual classification. A moisture jar sample was obtained at intervals not exceeding 5 feet through the depth of boring. A representative bulk soil bag sample of approximately 30 pounds was obtained from each soil horizon per 1,000 lineal feet of roadway. Consequently, a bag sample was collected from each of borings B-9, B-13, B-16, B-19, and B-21. Borings B-8 through B-21 were drilled to depths of between 2.4 and 12.3 feet.

4.1.4 Embankment Borings

Embankment borings were obtained in borings B-3a, B-3b, B-22, and B-23. The Standard Penetration Tests were performed generally in 1.5-foot increments at intervals not exceeding 5 feet through the overburden to the top of bedrock. Rock cores were obtained to the originally planned elevations in borings B-3a and B-3b; NQ size diamond coring tools were used. Borings B-3a, B-3b, B-22, and B-23 were drilled to depths of 20, 20.5, 13.3, and 5.7 feet, respectively. Upon completion of the borings, the soil samples and the rock cores were transported to DLZ's office and logged by the project geologist. The geologist determined the depth of the RDZ for each boring, and also determined the percent recovery and RQD for each core run.

Additional borings were drilled offset from borings B-22 and B-23 to obtain Shelby tube samples. Two Shelby tube samples were taken from boring B-22 at the depths of 1 foot and 6 feet, and one Shelby tube sample from boring B-23 at a depth of 2 feet.

4.1.5 Pavement and Subgrade Undisturbed Borings

Pavement and subgrade undisturbed borings were drilled in borings B-24 through B-27 by augering through the existing pavement and the underlying dense-grade aggregate (DGA) or subbase. The pavement and DGA thicknesses were recorded for each boring. Below the DGA or subbase materials, Standard Penetration Test samples were collected to the top of bedrock. Borings B-24 through B-27 were drilled to depths of between 4.9 and 9.4 feet.

Additional borings were drilled offset from borings B-24 and B-26 to obtain Shelby tube samples. One Shelby tube sample was taken from each boring at a depth of 2 feet.

4.2 Generalized Subsurface Conditions

The following sections present the generalized subsurface conditions encountered by the borings. For more detailed information, please refer to the boring logs presented in the Appendix. Please note that the strata contact lines shown on the boring logs represent approximate boundaries between soil and rock layers. In the field, the actual transitions between soil and bedrock layers might be different both vertically and laterally.

4.2.1 Surface Material

The surface materials encountered in the borings generally consisted of either 1.5 to 2.5 inches of topsoil or 6 to 12 inches of asphalt pavement. Below the asphalt pavement, borings B-24 through B-27, drilled along Commerce Parkway encountered approximately 3 to 5 inches of dense graded aggregate (DGA). Neither pavement materials nor topsoil was encountered in borings B-1, and B-20 through B-23.

4.2.2 Probable Fill Materials

Probable fill material consisting primarily of low plasticity lean clay with trace sand was encountered at depths of between 0 and 2.5 feet in boring B-23, while probable fill material consisting primarily of low plasticity silt with sand was encountered below the topsoil at depths of between 0.1 and 3.5 feet in boring B-41.

4.2.3 Lean Clays and Fat Clays

Beneath the ground surface, surface material or probable fill, the borings generally encountered residual soils consisting of low to high plasticity clays to the top of bedrock at depths varying from 0.5 to 13 feet. The upper portion of the clay soils generally contained trace organics. Fat clays (AASHTO A-7-6) were mostly encountered in the northern one-third of the proposed Allen Lane alignment (borings B-20 through B-23), near the existing railroad track. However, fat clays were also encountered in isolated areas south of the existing railroad tracks (borings B-1 and B-3a) and along Commerce Parkway (boring B-24). Fat clays (AASHTO A-7-5) were encountered in borings B-30 and B-32 drilled at the proposed bridge location. It should be noted that fat clays classified as AASHTO A-7-5 have plasticity index equal to or less than the difference between the soils' liquid limit and 30 while fat clays classified as AASHTO A-7-6 have plasticity index greater than the difference between the soils' liquid limit and 30. The fat clays classified as A-7-5 may be highly elastic in addition to being prone to shrink/swell with change in moisture contents as well as relatively low long term strength like fat clays classified as A-7-6. Hand penetrometer strength test values in the clay soils generally varied from 1.5 to 4.5 tons per square foot (tsf), indicating stiff to hard consistency.

4.2.4 Auger Refusal

Auger refusal was encountered in all of the borings at depths ranging from 0.5 to 13 feet below the existing ground surface (i.e. elevations ranging from 843.6 to 743.5 feet). While the depths to the auger refusal conditions varied across the site, the top of rock elevations generally increased from the south to the north along Allen Lane and generally increased from west to east along Commerce Parkway. The top of rock elevations generally increased from west to east along the proposed railroad runaround. Although the depths to refusal conditions did not appear to vary significantly over relatively short distances, the underlying bedrock could be pinnacled with crevices, mounds or valleys and such conditions might be present within the project areas and were not revealed in the borings drilled in this field exploration.

4.2.5 Bedrock

Rock coring was performed in borings B-1, B-2, B-3a, and B-3b drilled along the proposed Allen Lane alignment. The rock core samples generally consisted of a RDZ and very fine to fine grained, argillaceous, fossiliferous, brown and gray dolomite. Rock recovery ranged between 94 and 100 percent and the Rock Quality Designation (RQD) ranged between 82 and 100 percent, which corresponds to a Rock Quality Description of good to excellent according to Table 39 of FHWA-IF-02-034 *Geotechnical Engineering Circular No. 5 Evaluation of Soil and Rock Properties*.

4.3 Observation Wells and Groundwater Levels

During the field exploration, measurable groundwater levels were reported in some of the borings. A few borings, where the site conditions allowed, were left open for 24 hours after completion for longer-term water level measurements. Observation wells were installed in offset locations from borings B-2, B-3b, B-22, B-32, and B-41. The following table, Table 1, presents the elevations where groundwater was encountered during drilling (immediate water level) and where the groundwater level was encountered after the completion of drilling.

Table 1 – Groundwater Observations Summary

Boring No. (Ground Surface Elevation, ft)	Depth (Elevation) Water Level, ft			Depth (Elevation) to Bedrock, ft
	Depth (Elevation) to Immediate Water Level ¹	24 hrs After Completion	In Observation Well, Depth/ Elevation (Date Measured) ⁵	
B-2 (789)	4.5 (784.5)	4.8 (784.2)	5.9 / 783.0 (1-7-15)	8.5 (780.5)
B-3a (790.3)	2.7 (787.6)	5.9 (784.4)	N/A ⁴	5.0 (785.3)
B-3b (795.4)	5.1 (790.3)	6.8 (788.6)	3.7 / 791.8 (1-7-15)	5.5 (789.9)
B-14 (791.3)	NR ²	NR ²	N/A ⁴	8.8 (782.5)
B-15 (790.0)	NR ²	NR ²	N/A ⁴	7.4 (782.6)
B-19 (828.6)	NR ²	NR ²	N/A ⁴	3.6 (825)
B-21 (854.6)	10.9 (843.7)	NM ³	N/A ⁴	11.0 (843.6)
B-22 (856.2)	NR ²	NM ³	NR ²	13.0 (843.2)
B-30 (850.2)	10.7 (839.5)	NM ³	N/A ⁴	8.5 (841.7)
B-31 (854.5)	NR ²	NR ²	N/A ⁴	12.5 (842.0)
B-32 (854.6)	3.9 (850.7)	NM ³	NR ²	11.0 (843.7)
B-35 (846.0)	8.3 (837.7)	4.8 (841.2)	N/A ⁴	10.5 (835.5)
B-36 (855.4)	NR ²	NR ²	N/A ⁴	13.5 (841.9)
B-39 (849.1)	8.5 (840.6)	NM ³	N/A ⁴	6.0 (843.1)
B-40 (843.7)	5.2 (838.5)	3.7 (840.0)	N/A ⁴	6.5 (837.2)
B-41 (856.1)	NR ²	NM ³	NR ²	13.5 (842.6)

¹Water level reported before adding drilling water, measured from the ground surface.

²NR: Measured, but none reported.

³NM: Boring was NOT left open for 24-hr reading (not measured).

⁴N/A: No observation well was installed.

⁵Measured from the ground surface.

Groundwater level readings were taken from the observation wells on April 22, 2015. When DLZ personnel were at the site, part of the soil placed at the ground surface of the observation well was found to be missing. It should be noted that the soil placed at the ground surface was to prevent entry of surface water from entering the well. With the soil at the ground surface partially missing, the groundwater levels in the wells could likely include the surface runoff or rain water that might have entered into the wells, and

therefore were not considered true groundwater levels. Consequently, the groundwater level measurements taken on April 22, 2015 are not included in this report.

It should be noted that groundwater levels may fluctuate with seasonal variations and following periods of heavy or prolonged precipitation and, therefore, the readings indicated on the boring logs may not be representative of the long-term groundwater level. Long-term monitoring would be needed to obtain a more accurate estimate of the groundwater table elevation. Consequently, during construction or at other times during the project life, water levels may be higher or lower than observed at the time of this investigation.

5.0 LABORATORY TESTING AND RESULTS

5.1 General

Laboratory tests were performed in accordance with applicable AASHTO or Kentucky Methods of soil and rock testing specifications (KM) as specified in the KYTC Geotechnical Guidance Manual, dated June 2005. Where both AASHTO and KM standards are designated in the guidance manual, the KM procedure was used. The results of the laboratory tests are shown on a laboratory test summary tables in Appendix II and on the appropriate soil profile sheets in Appendix V.

5.2 Disturbed Soil Testing

The laboratory testing program consisted of visual classifications of all collected soil and decomposed rock samples, and general index tests on selected Standard Penetration Test samples. The general index tests consisted of grain-size analyses, moisture content, and plasticity determinations. The types of soils resulting from laboratory classification testing were either lean clay (CL or A-6) or fat clay (CH or A-7-6), which is in general agreement with the results of visual classification of all collected soil. However, the disturbed soil sample taken from boring B-27 (along Commerce Parkway) at depths of between 1.5 and 3 feet was classified as silty sand (SM or A-6). The in-place moisture contents of tested samples collected from Allen Lane varied approximately from 13 to 32 percent with an average of approximately 22 percent, while the in-place moisture contents of tested samples from Commerce Parkway were approximately between 18 and 22 percent with an average of approximately 20 percent.

Standard Proctor moisture-density testing was performed on the bulk soil bag samples collected from borings B-9, B-13, B-16, and B-19. The general index tests were also performed on each of the bag samples. The types of soil resulting from laboratory classification were mostly lean clay (CL or A-6), except the bag sample from boring B-19 was classified as lean clay (CL) under the Unified Soils Classification System (USCS), but was classified as A-7-6 under AASHTO soil classification because of the liquid limit of the sample exceeding 40. The maximum dry densities of the four tested bag samples were approximately between 111.7 to 121 pcf with the optimum moisture contents varying approximately from 13.1 to 16.1 percent.

Based on the results of the moisture-density relation tests, the average in-place moisture contents of disturbed test samples collected along Allen Lane are approximately 6 to 9 percent higher than the respective optimum moisture contents.

California Bearing Ratio (CBR) testing was planned to perform on the bag samples from boring B-9, B-13, B-16, and B19 in conjunction with the moisture-density relation tests. However, because of insufficient samples from boring B-13, B16, and B-19, CBR testing was conducted on combined samples from B-13 and B-16, and no CBR testing was performed on the sample from B-19. The results indicated CBR values of 6.4 and 8.2, for samples compacted to 105 to 110 percent of the respective Standard Proctor maximum dry density with initial moisture content near optimum.

5.3 Shelby Tube Soil Testing

General index tests and unconfined compressive strength test were performed on two selected Shelby tube samples collected from borings B-24 and B-26. The sample from boring B-24 at depths of 2 to 4 feet was classified as fat clay (CH or A-7-6) with an in-place moisture content of approximately 25 percent and an unconfined compressive strength of 2,889 pounds per square foot (psf). The sample from boring B-26 at depths of 2 to 4 feet was classified as lean clay (CL or A-6) with an in-place moisture content of approximately 19 percent and an unconfined compressive strength of 6,142 psf.

5.4 Rock Core Testing

The Slake Durability Index (SDI) and Jar Slake (JS) tests provide indications of the effects weathering will have on the bedrock when exposed in open cut faces. Shale recovered from the rock coring operations was subject to these tests. The following table, Table 2, summarizes the results of the SDI and JS tests on selected shale samples.

Table 2 – Slake Durability and Jar Slake Test Results Summary

Boring/ Depth, ft	SDI, %	Fragment Type	Classification	JS Category
B-30/ 18.5 – 19.5	63.9	III	Non-durable Class II	4
B-30/ 30 – 30.6	98.9	I	N/A*	N/A*
B-39/ 16.9 – 17.5	54.0	II	Non-durable Class II	3
B-39/ 26.3 – 27.5	95.1	I	N/A*	N/A*
B-41/ 27.8 – 28.4	79.8	II	Non-durable Class I	4

*The sample was re-classified as dolomite.

Unconfined compression tests were performed on ten cores of the Laurel Dolomite. The unconfined compressive strengths of the dolomite ranged from 1,720 to 15,748 psi; the average strength was 7,817 psi.

6.0 ENGINEERING ANALYSES

Based on the current design information, it is anticipated that construction of the new Allen Lane will mostly require grade cuts of up to approximately 26 feet and placement of fills of up to approximately 7 feet. The larger amounts of grade cuts (greater than 14 feet) are generally required to accommodate the proposed alignment shift to the west and the proposed grade separation at the Allen Lane/CSX railroad intersection, between Sta. 168+00 and Sta. 174+00. According to the proposed finished grade along Allen Lane, the subgrade for the new pavement will consist of either the existing cohesive soils of low to high plasticity, existing RDZ, underlying bedrock or new fill.

For the construction of the temporary railroad diversion track, it is anticipated that fills of up to approximately 10 feet will be placed within approximately 80 to 85 feet north of the proposed bridge location.

The existing Commerce Parkway will be widened to add turn lanes, which will require cuts of up to approximately 12 feet in the existing embankment along the north side of Commerce Parkway will be required. A minimal amount of road improvement, consisting primarily of some “sliver fills” of relatively low heights and thicknesses, is planned on the south side of Commerce Parkway, within the existing right-of-way.

A table summarizing the estimated amounts of cuts and fills along the proposed roadway alignments, measured groundwater levels at the borings, and the top of bedrock elevations is included in Appendix III.

6.1 Correction of Standard Penetration Test Data

Standard correlations for the Standard Penetration Test (SPT) are based upon the blow counts (N-values) determined by a safety hammer (rope and cathead) system, which is generally estimated to be 60 percent efficient. Thus, the measured SPT N-values are termed as N_{60} data. The automatic hammers used for this exploration were tested and reported to be between 74 and 89.9 percent based on the calibration test results in 2014. Consequently, the measured SPT N-values need to be corrected to normalized N_{60} -values. The measured SPT N-values and the normalized N_{60} -values for each boring is included in the summary table of laboratory test results in Appendix II.

6.2 Soil and Rock Parameter Selections

The subsurface profile for the analyses used the stratigraphy disclosed by the borings and material properties were estimated from normalized Standard Penetration Test blow counts (N_{60} -values), visual classification, index properties, unconfined compressive strengths, and engineering judgment. The federal government’s Naval Facilities Design Manual (NAVFAC DM-7.2) and the FHWA’s Soils and Foundations Workshop Manual

were used as guide in estimating the soil and rock parameters used for the analyses. Additional published engineering literatures were also used, wherever applicable, to provide additional references for the soil and rock parameters. Generally, the parameters derived for the subsurface materials are typical of cohesive and bedrock materials found in the project area. The soil and rock properties selected for the analyses are presented in following sections.

6.3 Slope Stability Analyses

The global stability analyses, considering the short term and long-term conditions, were performed for the selected critical sections. The global stability analysis for an intermediate-term condition will also be performed for the critical cut sections in soil. The short term analyses considered undrained shear strength parameters; whereas the intermediate-term and long-term analyses considered drained shear strength parameters. The stability evaluations were performed using the GeoStudio 2012 software package with the SLOPE/W module. SLOPE/W is a software product for analyzing limit equilibrium to solve slope stability problems using the method of slices. Stability analyses were performed using Spencer's method, assuming potential circular failure surfaces. Furthermore, it was assumed that potential failure surfaces did not extend below the bottom of the rock disintegration zone.

6.3.1 Allen Lane

At the ground surface, all of the borings drilled along the proposed alignment, except for borings B-1, B-20, and B-21, generally encountered between 1.5 to 2.5 inches of topsoil or between 6 and 12 inches of pavement materials. Neither pavement materials nor topsoil was encountered in borings B-1, B-20, and B-21. Below the ground surface or the surface materials, the borings generally encountered approximately 6 inches to 12 feet of cohesive soils underlain by limestone or dolomite bedrock. The cohesive soils encountered consisted primarily of lean clay (CL or A-6); however, fat clay (CH or A-7-6) was encountered in borings B-1, B-3a, B-20, and B-21 at depths of between 0 and 12 feet.

Fill Sections

Based on the current design plan available, it is anticipated that placement of fills of up to approximately 7 feet will be required approximately between Sta. 160+50 and Sta. 166+50. Given the boring information, the new fill will be placed on layers of lean clay, fat clay, or interbedded layers of both. According to the current KYTC Geotechnical Guidance Manual and discussions with KYTC, stability analyses are generally performed for embankment sections over 20 feet high or for embankment sections of lesser height if unusual subsurface conditions are present. It is our understanding that although isolated fat clay was present along the proposed alignment, the subsurface conditions encountered in the boring locations are considered typical in the project area and that embankment

slopes of 2H:1V or flatter are generally used for the placement of new fill without the need for analytical justification.

Cut Sections Between Sta. 137+75 and Approximate Sta. 168+00

It is anticipated that construction of the proposed Allen Lane will require grade cuts of up to approximately 14 feet between Sta. 137+75 (beginning station) and approximate Sta. 168+00. Slope stability analysis for cut sections took into account soil and bedrock thickness at the sections and the subsurface conditions encountered in the field exploration. The most critical cut section is considered to be constructed in the thickest layers of cohesive soils, and a generalized subsurface condition was used for the analysis of the critical section. Based on a review of the soil types and thicknesses encountered within cut intervals, it is apparent that the cuts will be constructed in cohesive soils (clays of low to high plasticity), decomposed limestone or dolomite (RDZ), and the underlying limestone or dolomite bedrock. Given the current design plan available, the cut section at approximate Sta. 140+00 will be constructed in approximately 14 feet of cohesive soil (measured from existing groundline to proposed ditchline) underlain by bedrock, which is considered the most critical cut section for the short-term (undrained shear strength), intermediate-term and long-term (drained shear strength) slope stability analyses. In the analysis, the groundwater level was assumed to be 2 feet above the soil-rock interface.

After discussions with KYTC, the effective shear strength parameters (intermediate-term) consisting of a cohesion value of 200 psf and a friction angle of 26 degrees were selected to be used for the low to medium plasticity soils at this site. It should be noted that according to the KYTC Geotechnical Guidance Manual, the cohesion for long-term cut slope stability analyses could be reduced to 20 percent of the value used in the intermediate-term analysis (drained shear strength) or to zero in areas with highly plastic clays, severe swelling or softening, or large potentials for sloughing failures. The following tables, Tables 3 and 4, summarize the soil and rock properties used and the results of the stability analyses.

Table 3 – Allen Lane Sta 140+00 X-Section Shear Strength Parameters

	Cohesive Overburden			Rock Disintegration Zone		
	c/c' (psf)	ϕ/ϕ'	γ/γ' (pcf)	c/c' (psf)	ϕ/ϕ'	γ/γ' (pcf)
Short-term (Undrained)	1,000	0°	130	0	40	145
Intermediate-term	200	26	130	0	40	145
Long-term (Drained)	40	26	130	0	40	145

Table 4 - Allen Lane Sta 140+00 X-Section Summary of Cut Stability Analyses

Station	Slope Geometry (H:V)			F.S./Target F.S.		
	Cohesive Overburden	Rock Disintegration Zone	Bedrock	Short-term	Inter-mediate-term	Long-term
140+00	2:1	N/A	N/A	3.5/1.2-1.4	2.2/1.2-1.4	1.4/1.4-1.6

N/A: The bottom of the cut is within overburden.

6.3.2 Commerce Parkway

It is anticipated that cuts of up to approximately 12 feet in the existing embankment along the north side of Commerce Parkway will be required. Based on the current design plan available, the top of the groundline elevations along the proposed cut area vary from 766 to 755 feet, while the proposed ditchline elevations will be between 749 and 757 feet. Four borings (B-24 through B-27) were drilled on the existing pavement along Commerce Parkway and bedrock was encountered at depths of between 4 and 8.5 feet or elevations between 743.5 and 754.5 feet, with the top of bedrock elevations increasing from west to east. It is apparent that the cuts will be constructed in cohesive soils (clays of low to high plasticity), decomposed limestone or dolomite (RDZ), and the underlying limestone or dolomite bedrock. The most critical cut section is considered to be constructed in the thickest layers of cohesive soils, which is similar to the most critical section selected for stability analysis along Allen Lane. Due to the close proximity of Commerce Parkway to the critical section analyzed for Allen Lane, results of the stability analyses for Allen Lane will also apply to Commerce Parkway. Consequently, a separate stability analysis for Commerce Parkway was not performed.

6.3.3 Temporary Railroad Diversion Track (Railroad Runaround)

For the construction of the temporary railroad diversion track, it is anticipated that fills of up to approximately 10 feet will be placed within approximately 80 to 85 feet north of the proposed bridge location to match with the top elevation of the existing railroad tracks located at approximately 863 feet. Borings B-20, B-22, and B-23 were drilled either along the proposed railroad runaround alignment or approximately within 100 feet north of the proposed railroad runaround alignment and generally encountered varying thicknesses of cohesive soils of mostly high plasticity underlain by dolomite bedrock approximately at elevations 844.2, 843.6, and 856.1 feet, respectively. Borings B-28, B-31, B-32, B-36, B-37, and B-41 were drilled for the construction of the proposed bridge and were located within 25 feet south of the proposed railroad alignment. These bridge borings generally encountered cohesive soils of high plasticity underlain by bedrock approximately at elevations between 839.7 and 843.7 feet. The final logs for these bridge borings are included in Appendix I for reference.

Based on the subsurface conditions encountered in the borings drilled in the vicinity of the proposed railroad runaround and the existing ground surface elevations (varying approximately from 848 to 853 feet) at the proposed railroad runaround location where the maximum amount of fill is anticipated, it is apparent that the foundation soils of the railroad embankment will likely consist of up to approximately 13 feet of cohesive soils of high plasticity underlain by dolomite bedrock approximately at elevations between 839.7 and 843.7 feet, except at boring B-23 where bedrock is anticipated approximately at elevation 856 feet. Since the most critical embankment section is considered to be constructed with the thickest layer of cohesive soil, the foundation soil profile used in the stability analysis was conservatively assumed to consist of approximately 13 feet of cohesive soils of high plasticity. Below the cohesive soils, a generalized bedrock condition was assumed for the stability analysis. In the analysis, the groundwater level was assumed to be 2 feet above the soil-rock interface and a vertical live load surcharge of 1,880 psf (distributed over a standard length of a railroad tie, 8'-6") was used based on the recommendation indicated in the appendix of the "*CSXT Public Project Information*", last revised on August 10, 2012. It should be noted that the vertical railroad surcharge was applied in the stability analysis for the short-term (undrained) condition only.

It is our understanding that the temporary railroad runaround embankment is planned to be constructed with 2H:1V side slopes due to right-of-way constraints. Stability analyses were performed using the desired side slopes of 2H1:1V and assuming that cohesive soils with low plasticity are permitted for use in railroad embankment construction. Highly plastic clay soils should not be used for embankment fill.

After discussions with KYTC and using the empirical correlations for drained shear strengths from a literature search, the effective shear strength parameters consisting of a cohesion value of 200 psf and a friction angle of 20 degrees were selected to be used for the highly plastic soils at the site for the intermediate-term analysis. In the long-term stability analysis, a cohesion of 40 psf and friction angle of 20 degrees were used to account for the possible severe swelling or softening, or large potentials for sloughing failures. Detailed calculation of the estimated drained shear strength is included in Appendix III. The soil and rock properties used and the results of the stability analyses are summarized in the following Tables 5 and 6.

Table 5 – Railroad Runaround Embankment Shear Strength Parameters

	Cohesive (Lean Clay) Fill for Proposed Railroad Runaround Embankment			Existing Foundation Soils (Fat Clay)		
	c/c' (psf)	ϕ/ϕ'	γ/γ' (pcf)	c/c' (psf)	ϕ/ϕ'	γ/γ' (pcf)
Short-term (Undrained)	1,500	0°	125	1,000	0	130
Long-term (Drained)	270 ¹	28 ¹	125	40	20	130

¹The federal government's Naval Facilities Design Manual (NAVFAC DM-7.2).

Table 6 - Summary of Embankment Stability Analyses (Railroad Runaround)

Station	Slope Geometry (H:V)			F.S./Target F.S. ¹	
	Proposed Railroad Runaround Embankment ¹	Rock Disintegration Zone	Bedrock	Short-term	Long-term
1529+50	2:1	N/A ²	N/A ²	3.0/1.1-1.3	2.0/1.4-1.6

¹In the analyses, the railroad surcharge of 1,880 psf was applied for the short-term condition only.

²N/A: The bottom of the embankment is within overburden.

6.3.4 Cut Section for Grade Separation Outside Proposed Bridge Location (between approximate Sta. 171+00 and Sta. 175+13.61)

The proposed project consists primarily of lowering the existing Allen Lane at the CSX railroad, and relocating the existing Allen Lane slightly to the west in order to provide a grade separation at the Allen Lane/CSX railroad intersection. Based on the current design information, it is anticipated that construction of the new Allen Lane will mostly require grade cuts of up to approximately 18 feet at approximate Sta. 171+00. The existing ground surface elevation at Sta. 171+00 is approximately at 858 feet and the proposed ditchline at Sta. 171+00 will be approximately at 840 feet.

Borings B-20 and B-21 were drilled along the proposed Allen Lane alignment and generally encountered varying thicknesses of cohesive soils of high plasticity underlain by dolomite bedrock approximately at elevations 844.2 and 843.6, respectively. Borings B-28 through B-43 were drilled for the proposed railroad bridge. However, borings B-29, B-33, B38, and B-42 were eliminated from the boring program during the field exploration because of site access constraints. The bridge borings generally encountered cohesive soils of high plasticity underlain by bedrock approximately at elevations between 835.5 and 843.7 feet. The final logs for these bridge borings are included in Appendix I for reference.

Based on a review of the soil types and thicknesses encountered within the cut intervals, it is apparent that the cuts will be constructed in cohesive soils (predominantly clays of high plasticity), decomposed limestone or dolomite

(RDZ), and the underlying limestone or dolomite bedrock. Given the top of bedrock elevations in the borings drilled near the grade separation area varying from 844.2 to 835.5 feet, the existing grade at Sta. 171+00 approximately at 858 feet, and the proposed ditchline at Sta. 171+00 approximately at 840 feet, the critical cut section at Sta. 170+25 will be constructed in approximately 14 (858 minus 844.2) to 18 (858 minus 840) feet of cohesive soil underlain by bedrock. Since the most critical embankment section is considered to be constructed in the thickest layer of cohesive soils, the critical cut section used in the stability analysis was conservatively assumed to consist of 18 feet of cohesive soils of high plasticity. Below the cohesive soils, a generalized bedrock condition was assumed for the stability analysis. In the analysis, the groundwater level was assumed to be 2 feet above the soil-rock interface and a vertical live load surcharge of 250 psf was applied in the stability analysis for the short-term (undrained) condition only to account for any traffic surcharge or construction loads. It should be noted the railroad surcharge of 1,880 psf was not used for the analyses outside of the proposed bridge location.

It is our understanding that the cut slopes are planned to be constructed with side slopes no flatter than 3H:1V due to right-of-way constraints. The stability analyses using a 3H:1V cut slope were performed and resulted in a factor of safety of 1.4 for the long-term condition, which is the minimum required factor of safety. Consequently, cut slopes steeper than 3H:1V are not considered acceptable unless a slope retaining system or other slope stabilization applications are used. The soil and rock properties used in the analyses and the analytical results are summarized in the following Tables 7 and 8.

**Table 7 - Shear Strength Parameters
(Grade Separation Outside the Proposed Bridge Location)**

	Existing Cohesive Soils (Fat Clay) in Cut Slopes			RDZ		
	c/c' (psf)	ϕ/ϕ'	γ/γ' (pcf)	c/c' (psf)	ϕ/ϕ'	γ/γ' (pcf)
Short-term (Undrained)	1,000	0	130	0	40	145
Intermediate-term	200 ¹	20	130	0	40	145
Long-term (Drained)	40	20	130	0	40	145

**Table 8 - Summary of Cut Section Stability Analyses
(Grade Separation Outside the Proposed Bridge Location)**

Station	Slope Geometry (H:V)			F.S./Target F.S.		
	Cut Sections ¹	Rock Disintegration Zone	Bedrock	Short-term	Intermediate-term	Long-term
171+00	3:1	N/A ¹	N/A ¹	3.0/1.2-1.4	2.1/1.2-1.4	1.4/1.4-1.6

¹N/A: The bottom of the cut is within overburden.

6.4 Settlement Analyses

The settlement analyses were performed in general accordance with the FHWA's Soils and Foundation Workshop Manual (NHI-00-045, July 2000).

6.4.1 Allen Lane

Based on the current design information, the placement of fills of up to approximately 6 feet is anticipated between approximately Sta. 160+50 and Sta. 166+50. Borings B-3a, b-3b, B-17, and B-18 were drilled approximately between Sta. 161+49 and Sta. 166+04 and encountered bedrock at depths of between 6 inches and 5.5 feet below the existing ground surface. According to the KYTC Geotechnical Guidance Manual and the recent discussions with KYTC, settlement analysis is required for embankment sections over 20 feet in height and the thickness of the compressible foundation soil is greater than 10 feet. It is our understanding that although isolated fat clay was present along the proposed alignment, the subsurface conditions encountered in the boring locations are considered typical in the project area and that settlement analyses would not be necessary for the anticipated amount of new fill.

6.4.2 Commerce Parkway

The improvement to the existing Commerce Parkway will mostly require grade cuts of up to approximately 12 feet in the existing embankment along the north side of Commerce Parkway. However, a minimal amount of road improvement, consisting primarily of some "sliver fills" of relatively low heights and thicknesses, is anticipated on the south side of Commerce Parkway, within the existing right-of-way. Consequently, settlement analyses will not be required because of the anticipated sliver fills.

6.4.3 Temporary Railroad Diversion Track (Railroad Runaround)

For the construction of the railroad runaround, it is anticipated that fills of up to approximately 10 feet will be placed within approximately 80 to 85 feet north of the proposed bridge location. The soil profile used for the stability analysis as described in Section 6.3.3 of this report was used for the settlement analysis. In the analysis, the groundwater level was assumed to be 2 feet above the soil-rock interface. Result of the analysis indicated that the total settlement on the order of 2 inches was estimated at the center of the embankment. Using an estimated coefficient of consolidation of $0.18 \text{ ft}^2/\text{day}$ based on an average liquid limit of 70 for the soil (Ref. NAVFAC DM 7.1), a preliminary time dependent settlement calculation was performed to estimate the time required for 90% of the estimated total settlement to occur. Result of the analysis indicated that it may take up to 2 years for 90% of the estimated total settlement to fully occur because of the inherent characteristics of fat clay and the underlying "impermeable" bedrock. Consideration may be given to constructing the proposed railroad embankment as

early as possible in construction before the railroad tracks are constructed. Settlement platforms are recommended to verify primary consolidation of the foundation soil is completed prior to the construction of the railroad tracks.

According to the settlement analyses, approximately 1 inch of settlement would likely occur in the upper 5 feet of existing highly plastic clay. Replacement of this highly plastic clay with compacted granular material may be considered to reduce the estimated total settlement due to the added embankment fill.

6.4.4 Grade Separation at Side Slopes of Proposed Bridge Location

The proposed project consists primarily of lowering the existing Allen Lane at the CSX railroad, and relocating the existing Allen Lane slightly to the west in order to provide a grade separation at the Allen Lane/CSX railroad intersection. It is anticipated that construction of the new Allen Lane will mostly require grade cuts. However, given the existing ground surface elevations (approximately between 846 and 848 feet) at the south side of the proposed bridge abutments and the proposed bridge grade approximately at elevation 861, placement of fills of up to 15 feet will be required for the approach embankments at south side of the bridge abutments.

Based on the soil types and thicknesses encountered in the borings drilled for the proposed bridge, the top of bedrock elevations in the boring locations varied from 843.7 to 835.5 feet, the subsurface conditions at the new fill areas will likely consist of up to 11 to 13 feet of clay of high plasticity underlain by bedrock. Details of the settlement analysis are presented in the geotechnical report for the proposed bridge, which will be presented under separate cover.

7.0 GEOTECHNICAL NOTES AND RECOMMENDATIONS

The following geotechnical notes and recommendations are based upon reviews of available data, information obtained during the field exploration, results of laboratory testing, engineering analyses, and discussions with KYTC.

7.1 Geotechnical Notes

1. Clearing and grubbing of embankment areas shall be completed in accordance with Section 202 of the current Kentucky Transportation Cabinet (KYTC) Standard Specifications for Road and Bridge Construction.
2. Removal of existing structures and other obstructions, whether shown on the plans or not, shall be completed in accordance with Section 203 of the current KYTC Standard Specifications for Road and Bridge Construction.
3. If applicable, all water wells within the limits of construction, whether shown on the plans or not, shall be plugged in accordance with requirements of Section 708 of the current KYTC Standard Specifications for Road and Bridge Construction.

4. If applicable, all catch basins and manholes shall be filled and capped, and all septic tanks, if any, shall be cleaned and filled in accordance with Section 708 of the current KYTC Standard Specifications for Road and Bridge Construction.
5. Any drainage swales, saturated, soft and unstable areas encountered within proposed embankment foundation limits and/or any other areas as specified by the Engineer shall be stabilized with a minimum of two feet (vertical thickness) of granular materials (KYTC Coarse Aggregate No. 2) in accordance with Section 805 of the current KYTC Standard Specifications for Road and Bridge Construction, and the materials shall be classified as non-erodible, as directed by the Engineer. Additional granular material may be required to stabilize the embankment foundations and to maintain positive drainage. The actual thickness and locations of granular material shall be determined by the Engineer during construction. The granular materials shall be wrapped (top and bottom) with Type IV Geotextile Fabric in accordance with Sections 214 and 843 of the current Standard Specifications. Positive drainage shall be maintained to prevent trapping water within the roadway embankment.
6. Any ponds lying within the staked construction limits shall be drained, cleaned out, and filled in accordance with Section 206 of the current KYTC Standard Specifications for Road and Bridge Construction. Normally, a minimum of three feet (vertical thickness) of KYTC Coarse Aggregate No. 2 or shot rock of similar size, quality, and gradation approved by the Engineer is used for stabilization. A retention pond presently exists at approximately 50 feet east of existing Allen Lane and approximately 150 feet south of Artisan Parkway (approximately Sta. 161+00). This existing retention pond may be impacted if additional right-of-way is required. Detailed dimensions of any impacted ponds shall be determined prior to construction for calculating backfilling quantities.
7. The Contractor is responsible for conducting any operations necessary in order to excavate the cut areas to the required typical sections. These operations shall be incidental to the roadway excavation price.
8. The Contractor shall conduct grading operations in such a manner that bedrock obtained from excavation below the base of RDZ shall be stockpiled separately or otherwise re-conditioned so as to be available for use in those areas requiring said material. No direct payment will be allowed for such necessary re-conditioning as stockpiling, re-handling the material, and/or hauling.
9. All channel changes, excavation of surface ditches, and construction of special ditches shall be performed in accordance with Sections 204 and 206 of the current KYTC Standard Specifications for Road and Bridge Construction, prior to placement of any embankment materials adjacent to them. The construction of the embankment shall be completed in accordance with Section 206 of the current KYTC Standard Specifications for Road and Bridge Construction. At the direction of the Engineer, materials excavated from these areas may be utilized in construction of the embankments, but may require aeration or other moisture adjustments to obtain proper moisture contents prior to compaction operations.

10. Fat clay or shale shall not be used in construction of the embankments.
11. In accordance with Section 206 of the current KYTC Standard Specifications for Road and Bridge Construction, the moisture content of embankment material shall not vary from the optimum moisture content, as determined by KM 64-511, by more than plus or minus two percent. This moisture content requirement shall have equal weight with the density requirement when determining the acceptability of embankment or subgrade construction. Refer to the Family of Curves for moisture-density relationships.
12. All soils, whether from roadway excavation or borrow, may require moisture adjustments to obtain proper moisture content prior to compaction. Direct payment shall not be permitted for rehandling, hauling, stockpiling and/or moisture adjusting soils.
13. All new fill materials shall be free of topsoil, organics, debris, or any deleterious material deemed by the Engineer. No frozen materials shall be incorporated into the fill, and no embankment, pavement, utilities, or fill shall be placed on top of frozen materials. Only suitable materials deemed by the Engineer shall be used as new fill materials.
14. No particle size larger than four inches in any direction, unless directed by the Engineer, shall be placed as fill within one foot of the finished subgrade elevation. Any particle size greater than four inches shall be broken down to less than four inches, or removed from the lift.
15. Borrow material, if needed, used for roadway subgrade, shall meet the minimum CBR value of 2.0.
16. When rock, including shale, is present at the roadway subgrade, within 12 inches of the bottom of the DGA, it shall be removed in accordance with Section 204 of the current KYTC Standard Specifications for Road and Bridge Construction and replaced with soil fill in accordance with Sections 206 and 207 of the current Standard Specifications.
17. A minimum one-foot working platform (extending under the curb and gutter) will be required in areas where the roadway subgrade is soft and/or saturated. The platform will consist of Kentucky Coarse Aggregate #2 in accordance with Section 805 of the current KYTC Standard Specifications for Road and Bridge Construction. The working platform shall be wrapped with Type IV Geotextile Fabric in accordance with Sections 214 and 843 of the current Standard Specifications. The actual locations and thickness shall be determined by the Engineer during construction and may depend on seasonal fluctuations in the water table. The working platform can also serve as a drainage blanket by placing perforated drain pipe into the bottom of the granular material. Positive drainage of the perforated drain pipe shall be maintained to reduce the possibility of trapping water within the subgrade.

18. Pavement underdrains shall be provided to reduce the possibility of trapping water within the subgrade.
19. Perforated pipe for subgrade drainage shall be placed in the vertical sag at the intersection of Allen Lane and Commerce Parkway (approximately Sta. 138+00 of Allen Lane alignment) in accordance with the current KYTC Standard Drawing RDP-005 and/or as directed by the Engineer.
20. The cut slopes in soils along Allen Lane (between Sta. 137+75.11 and approximate Sta. 168+00) and Commerce Parkway shall be constructed with 2H:1V or flatter slopes as indicated on the project plan. In addition to the cut limits identified on the project plan, additional minor cuts in soils (less than 4 feet in height) are required. Final slopes in the minor cut areas (less than 4 feet in height) shall be no steeper than 2H:1V, unless approved by the Engineer.
21. The cut slopes in soils in the grade separation area outside the proposed bridge location (approximately between Sta. 171+00 and Sta. 175+13.61 of Allen Lane alignment) shall be constructed with slopes no steeper than 3H:1V, unless a slope retaining system or other slope stabilization applications are used.
22. The cut slopes in the rock disintegration zones and bedrock shall be constructed with 2H:1V or flatter slopes.
23. The fill slopes along Allen Lane and Commerce Parkway shall be constructed with 2H:1V or flatter slopes. Benching requiring horizontal cuts into existing slopes shall be used in accordance with the applicable KYTC requirements.
24. The railroad runaround embankment side slopes shall be constructed with 2H:1V or flatter slopes with cohesive soils with low plasticity provided the cohesive soils are permitted for use in railroad embankment construction. Highly plastic clay soils shall not be used for embankment fill. Borrow material, if needed, used for embankment construction along Allen Lane shall consist of low swell potential cohesive soils (according to USCS or AASHTO soil classification) with liquid limit (as determined by AASHTO T-89) and plasticity index (as determined by AASHTO T-90) less than 50 and 30, respectively. All fill materials shall be compacted in accordance with Section 206 of the current KYTC Standard Specifications for Road and Bridge Construction. All fill materials shall be approved by the Engineer prior to the placement of fill.
25. Embankment stability analyses were conducted using estimated soil strength parameters for embankment material. Borrow material, if needed, used for embankment construction along Allen Lane shall consist of low swell potential cohesive soils (according to USCS or AASHTO soil classification) with liquid limit (as determined by AASHTO T-89) and plasticity index (as determined by AASHTO T-90) less than 50 and 30, respectively. All fill materials shall be compacted in accordance with Section 206 of the current KYTC Standard Specifications for Road

and Bridge Construction. All fill materials shall be approved by the Engineer prior to the placement of fill.

26. Embankment foundation benches are not anticipated at this time. If requested by the Engineer, embankment foundation benches/slope serrations shall be constructed and perforated pipe underdrains shall be placed, as applicable, in accordance with the current KYTC Standard Drawings RDP-006 and RGX-010. The benches shall be constructed one at a time beginning with the lowest bench. Each bench shall be backfilled prior to excavation of the next bench. These procedures shall be followed to help maintain stability of the existing slopes.
27. Transverse benching is not anticipated at this time. If requested by the Engineer, transverse benching shall be constructed and perforated pipe underdrains shall be placed, as applicable, in accordance with the current KYTC Standard Drawings and RDP-005 and RDP-006, as applicable. Contrary to the Standard Drawing RDP-006, transverse benches and perforated pipe underdrains shall be installed in both uphill and downhill transition areas between cuts and fills. In addition, perforated pipe underdrains shall be installed in any areas showing signs of seepage during construction, as directed by the Engineer.
28. Procedures shall be performed as required to control erosion and siltation in accordance with Sections 212 and 213 of the current KYTC Standard Specifications for Road and Bridge Construction.
29. The bedrock, except for those in RDZ, is strong dolomite/limestone with occasional interbedded shale. Hard rock excavation techniques will likely be necessary to remove the dolomite/limestone. **Rock blasting is not permitted for this project.** It is the Contractor's responsibility to select the appropriate and acceptable means and methods of construction and adequate construction equipment based on the anticipated subsurface conditions and to prevent damage to adjacent structures or facilities.
30. Consideration should be given to constructing the proposed railroad embankment as early as possible in construction before the railroad tracks are constructed. Settlement platforms are recommended to verify that primary consolidation of the foundation soil due to the placement of the embankment fill is completed prior to the construction of the railroad tracks.

7.2 Design Recommendations

1. A rock swell factor of 15 percent is recommended for materials excavated below the rock disintegration zone (RDZ).
2. An average soil shrinkage value of five (5) percent is recommended for soils to be excavated on this project. This value is to be applied in calculating an "apparent" shrinkage value. This shrinkage value should be applied only to soil positioned above

the top of rock. A shrink/swell value of zero should be applied to the weathered rock zone considered to be RDZ material.

3. The project should be designed using a CBR design value of 2.0. A CBR design value of 2.0 shall also be used for the material beneath the subgrade.
4. A minimum one-foot working platform (extending under the curb and gutter) will be required in areas where the roadway subgrade is soft and/or saturated as indicated in Geotechnical Note #17. The actual locations and thickness shall be determined by the Engineer during construction and may depend on seasonal fluctuations in the water table. The working platform can also serve as a drainage blanket by placing perforated drain pipe into the bottom of the granular material. For purpose of calculating quantities, assume 1,000 feet of roadway for this treatment.
5. Any drainage swales, saturated, soft and unstable areas encountered within proposed embankment foundation limits and/or any other areas as specified by the Engineer shall be drained, over-excavated and stabilized with a minimum of two feet (vertical thickness) of non-erodible granular materials (KYTC Coarse Aggregate No. 57) as indicated in Geotechnical Note #5. The actual thickness and locations of granular material shall be determined by the Engineer during construction. For purpose of calculating quantities, assume 1,000 feet of embankment foundation for this treatment.

8.0 SEISMIC SITE COEFFICIENT

The AASHTO LRFD Bridge Design Specifications, Seventh Edition provides guidelines for determining the seismic hazard at a site. The seismic hazard for a site is characterized by the acceleration response spectrum and the site factors for the relevant site classification. Based on the results of this field exploration, the site is classified as Seismic Site Class C. The following table summarizes the seismic hazard coefficients and the site factors.

Table 10 - Seismic Hazard Considerations¹

Acceleration Response Spectrum	
Peak Ground Acceleration (PGA)	0.06
Short Period Spectral Acceleration Coefficients (S_s)	0.14
Long Period Spectral Acceleration Coefficients (S_1)	0.058
Site Factors	
Factor at Peak Ground Acceleration Coefficient (F_{pga})	1.2
Factor at Short Period Range of Acceleration Spectrum (F_a)	1.2
Factor at Long Period Range of Acceleration Spectrum (F_v)	1.7

¹Based on The AASHTO LRFD Bridge Design Specifications, Seventh Edition 2014, Section 3.10

Based on the coefficients and factors listed above, the site classifies as Seismic Performance Zone 1.

9.0 SPECIAL CONSIDERATIONS

8.1 Excavations and Groundwater Considerations

All excavations should be constructed in accordance with applicable local, state, and federal safety regulations including the current OSHA Excavation and Trench Safety Standards (29 CFR Part 1926). Construction site safety generally is the sole responsibility of the contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. Additionally, the contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, and/or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom and to prevent damage to adjacent structures or buried installations.

Groundwater was encountered in borings B-2, B-3a, B-3b, B-21, B-30, B-32, B-35, B-39, and B-40 at elevations between 784.2 and 850.7 feet during the field exploration. The groundwater levels encountered were generally approximately 1.3 to 4 feet above the top of bedrock or at the overburden and bedrock interface in the respective borings except in borings B-30, B-32, and B-39. In boring B-32, the groundwater level encountered was approximately 7 feet above the top of bedrock. The groundwater levels encountered in borings B-30 and B-39 were approximately 2.2 to 2.5 feet below the top of bedrock in the borings. Groundwater levels, measured on January 7, 2015, in observation wells installed at boring B-2 and B-3b were at elevations 783 and 791.8 feet, respectively. These longer-term groundwater levels were approximately 2 to 2.5 feet above the top of bedrock in the borings. Observation wells installed at borings B-22, B-32, and B-41 were dry when groundwater level measurements were taken on January 7, 2015.

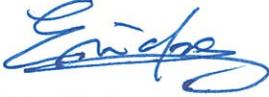
It should be noted that groundwater conditions vary seasonally and with the passage of time. Furthermore, due to the shallow depths to the underlying bedrock, groundwater could flow through the fractures and joints in the bedrock and water levels during construction or at other times during the project life may be higher or lower than observed at the time of this investigation. Seepage and groundwater should be anticipated during construction; therefore, the Contractor should be equipped to deal with groundwater, seepage, and surface water that may accumulate in the open excavations. Side slopes of the excavations and adjacent structures should be constantly monitored by a competent person having knowledge relative to slope stability for signs of yielding and potential failures. The Contractor should not be allowed to have any side slopes sloughing into the excavation. If sloughing occurs, then mechanical methods of stabilization or flatter sides slopes should be utilized.

10.0 CLOSING REMARKS

We appreciate having the opportunity to be of service to you on this project. Please do not hesitate to call if you have any questions concerning this report.

Respectfully submitted,

DLZ OHIO, INC.



Eric W. Tse, P.E.
Senior Geotechnical Engineer



Michael D. Kennedy, E.I.
Geotechnical Engineer



H. Jason Hughes, P.E. (Ohio)
Project Manager

EWT/MDK/HJH

M:\proj\0631\0006.02\Report (roadway)\REV Roadway Submittal (Sept 4 2015)\Oldham County Roadway FINAL (Sept 2015).doc

APPENDIX I

Project Location Quadrangle Map
General Information - Drilling Procedures and Logs of Borings
Boring Location Plan
Geologic Map with Boring Locations
Boring Logs – Forty-one (41) Borings
Summary of Rock Soundings

GENERAL INFORMATION DRILLING PROCEDURES AND LOGS OF BORINGS

Drilling and sampling were conducted in accordance with procedures generally recognized and accepted as standardized methods of investigation of subsurface conditions concerning geotechnical engineering considerations. Borings were drilled with either a truck-mounted or ATV-mounted drill rig.

Drive split-barrel sampling was performed in 1.5 foot increments at intervals not exceeding 5 feet. In the event the sampler encountered resistance to penetration of 6 inches or less after 50 blows of the drop hammer, the sampling increment was discontinued. Standard penetration data were recorded and one or more representative samples were preserved from each sampling increment.

In borings where rock was cored, NXM or NQ size diamond coring tools were used.

In the laboratory all samples were visually classified by a geotechnical engineer. Moisture contents of representative fine-grained soil samples were determined. A limited number of samples, considered representative of foundation materials present, were selected for performance of grain-size analyses and plasticity characteristics tests. The results of these tests are shown on the boring logs.

The boring logs included in the Appendix have been prepared on the basis of the field record of drilling and sampling, and the results of the laboratory examination and testing of samples. Stratification lines on the boring logs indicating changes in soil stratigraphy represent depths of changes approximated by the driller, by sampling effort and recovery, and by laboratory test results. Actual depths to changes may differ somewhat from the estimated depths, or transitions may occur gradually and not be sharply defined. The boring logs presented in this report therefore contain both factual and interpretative information and are not an exact copy of the field log.

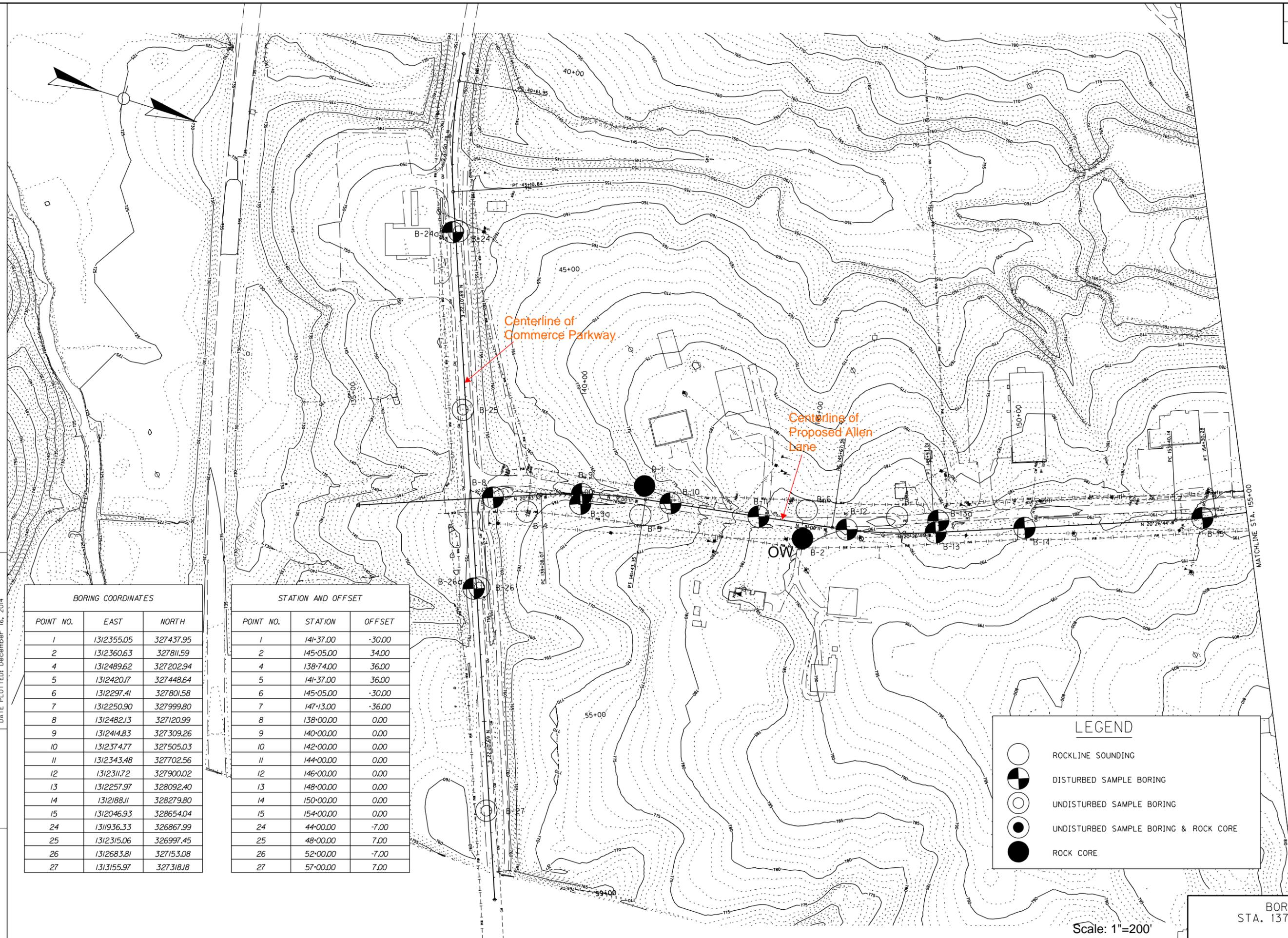
Although it is considered that the borings have disclosed information generally representative of site conditions, it should be expected that between borings conditions may occur which are not precisely represented by any one of the borings. Soil deposition processes and natural geologic forces are such that soil and rock types and conditions may change in short vertical intervals and horizontal distances.

Soil/rock samples will be stored at our laboratory for a period of six months. After this period of time, they will be discarded, unless notified to the contrary by the client.

MicroStation v8.11.9.357
 USER: mkennedy
 DATE PLOTTED: December 16, 2014

BORING COORDINATES		
POINT NO.	EAST	NORTH
1	1312355.05	327437.95
2	1312360.63	327811.59
4	1312489.62	327202.94
5	1312420.17	327448.64
6	1312297.41	327801.58
7	1312250.90	327999.80
8	1312482.13	327120.99
9	1312414.83	327309.26
10	1312374.77	327505.03
11	1312343.48	327702.56
12	1312311.72	327900.02
13	1312257.97	328092.40
14	1312188.11	328279.80
15	1312046.93	328654.04
24	1311936.33	326867.99
25	1312315.06	326997.45
26	1312683.81	327153.08
27	1313155.97	327318.18

STATION AND OFFSET		
POINT NO.	STATION	OFFSET
1	141+37.00	-30.00
2	145+05.00	34.00
4	138+74.00	36.00
5	141+37.00	36.00
6	145+05.00	-30.00
7	147+13.00	-36.00
8	138+00.00	0.00
9	140+00.00	0.00
10	142+00.00	0.00
11	144+00.00	0.00
12	146+00.00	0.00
13	148+00.00	0.00
14	150+00.00	0.00
15	154+00.00	0.00
24	44+00.00	-7.00
25	48+00.00	7.00
26	52+00.00	-7.00
27	57+00.00	7.00

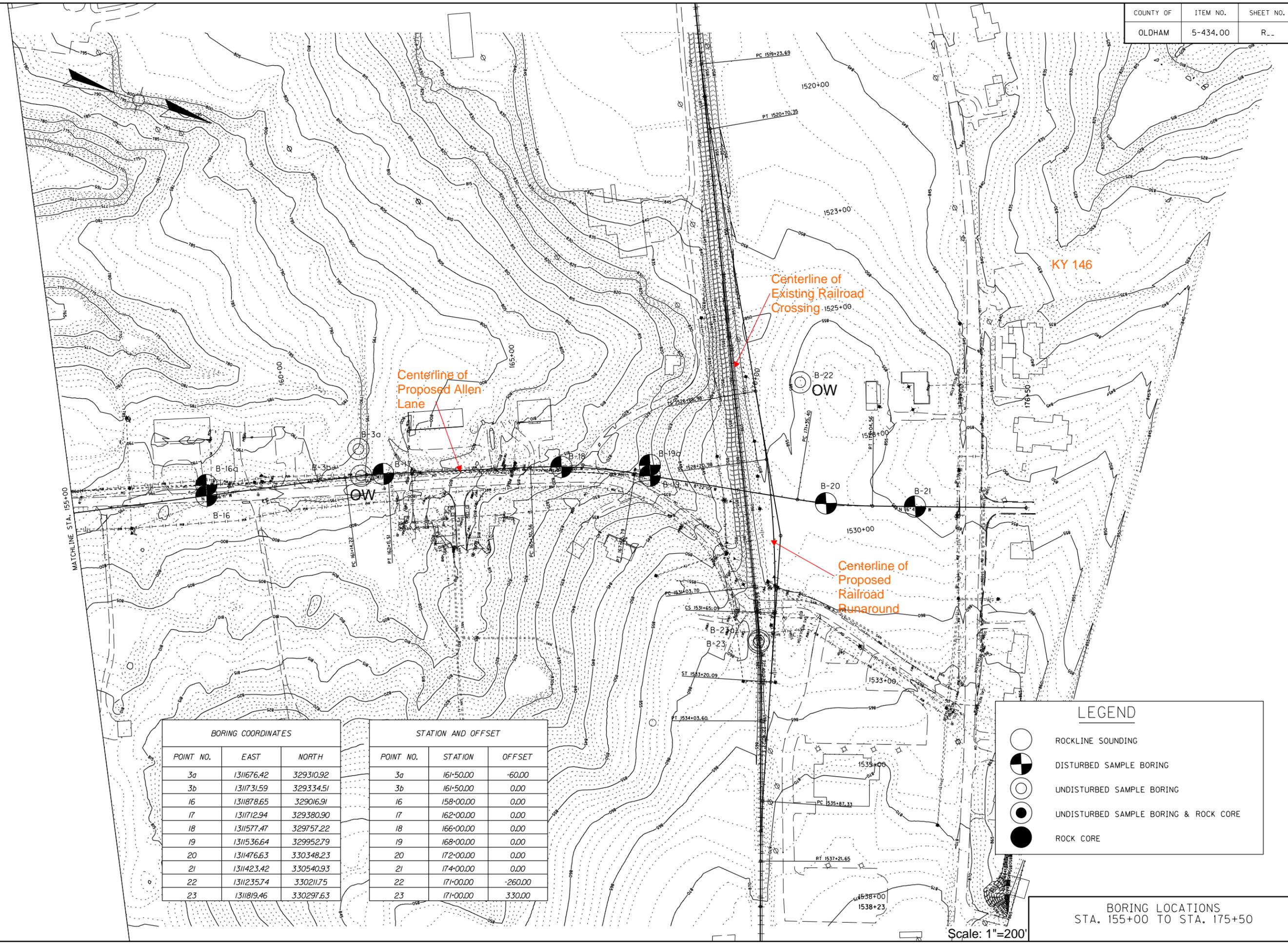


LEGEND

- ROCKLINE SOUNDING
- DISTURBED SAMPLE BORING
- UNDISTURBED SAMPLE BORING
- UNDISTURBED SAMPLE BORING & ROCK CORE
- ROCK CORE

BORING LOCATIONS
 STA. 137+65 TO STA. 155+00

Scale: 1"=200'



Centerline of Proposed Allen Lane

Centerline of Existing Railroad Crossing

Centerline of Proposed Railroad Runaround

KY 146

MATCHLINE STA. 155+00

BORING COORDINATES		
POINT NO.	EAST	NORTH
3a	1311676.42	329310.92
3b	1311731.59	329334.51
16	1311878.65	329016.91
17	1311712.94	329380.90
18	1311577.47	329757.22
19	1311536.64	329952.79
20	1311476.63	330348.23
21	1311423.42	330540.93
22	1311235.74	330211.75
23	1311819.46	330297.63

STATION AND OFFSET		
POINT NO.	STATION	OFFSET
3a	161+50.00	-60.00
3b	161+50.00	0.00
16	158+00.00	0.00
17	162+00.00	0.00
18	166+00.00	0.00
19	168+00.00	0.00
20	172+00.00	0.00
21	174+00.00	0.00
22	171+00.00	-260.00
23	171+00.00	330.00

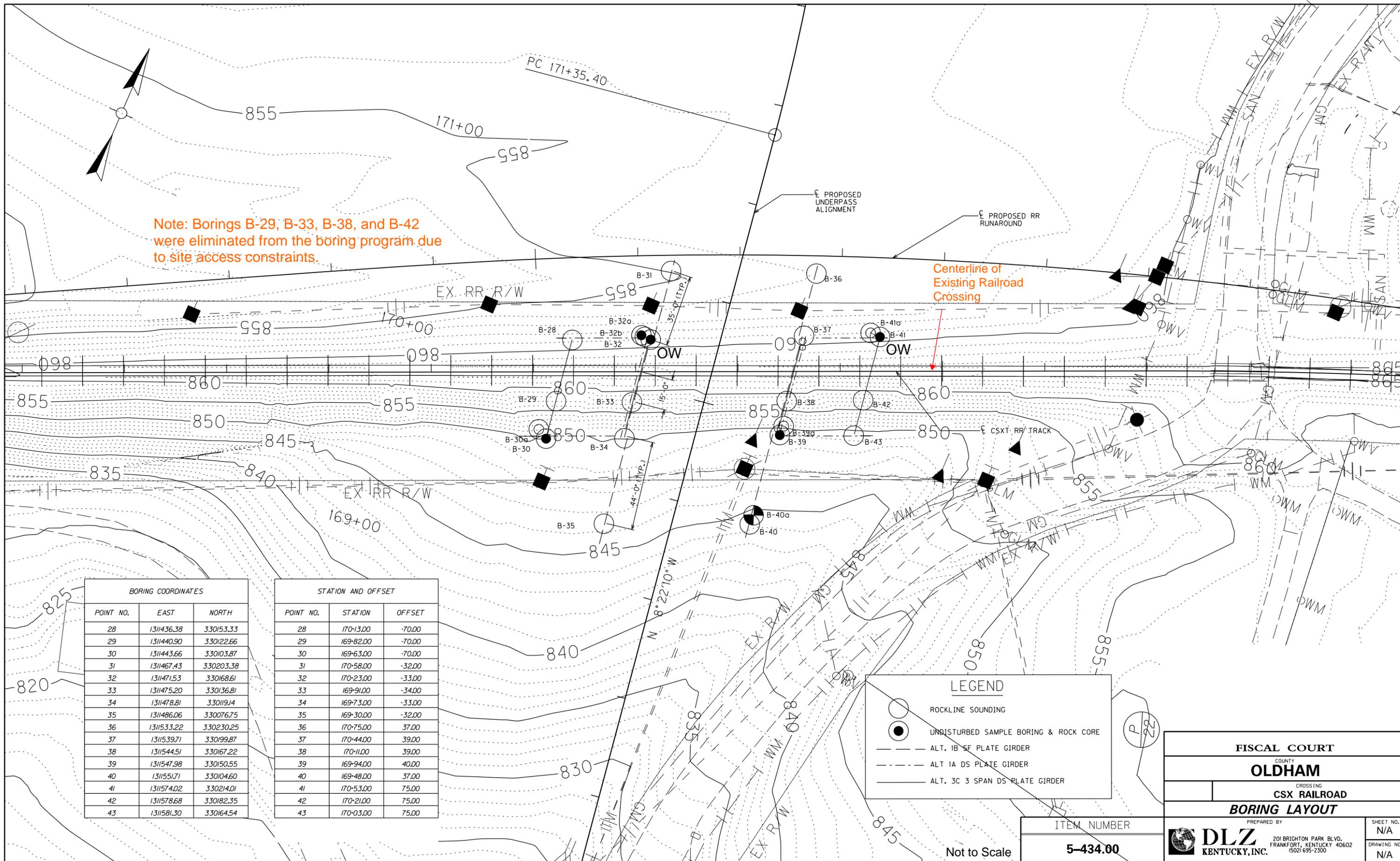
LEGEND

- ROCKLINE SOUNDING
- DISTURBED SAMPLE BORING
- UNDISTURBED SAMPLE BORING
- UNDISTURBED SAMPLE BORING & ROCK CORE
- ROCK CORE

BORING LOCATIONS
STA. 155+00 TO STA. 175+50

Scale: 1"=200'

Note: Borings B-29, B-33, B-38, and B-42 were eliminated from the boring program due to site access constraints.



BORING COORDINATES		
POINT NO.	EAST	NORTH
28	1311436.38	330153.33
29	1311440.90	330122.66
30	1311443.66	330103.87
31	1311467.43	330203.38
32	1311471.53	330168.61
33	1311475.20	330136.81
34	1311478.81	330119.14
35	1311486.06	330076.75
36	1311533.22	330230.25
37	1311539.71	330199.87
38	1311544.51	330167.22
39	1311547.98	330150.55
40	1311551.71	330104.60
41	1311574.02	330214.01
42	1311578.68	330182.35
43	1311581.30	330164.54

STATION AND OFFSET		
POINT NO.	STATION	OFFSET
28	170+13.00	-70.00
29	169+82.00	-70.00
30	169+63.00	-70.00
31	170+58.00	-32.00
32	170+23.00	-33.00
33	169+91.00	-34.00
34	169+73.00	-33.00
35	169+30.00	-32.00
36	170+75.00	37.00
37	170+44.00	39.00
38	170+11.00	39.00
39	169+94.00	40.00
40	169+48.00	37.00
41	170+53.00	75.00
42	170+21.00	75.00
43	170+03.00	75.00

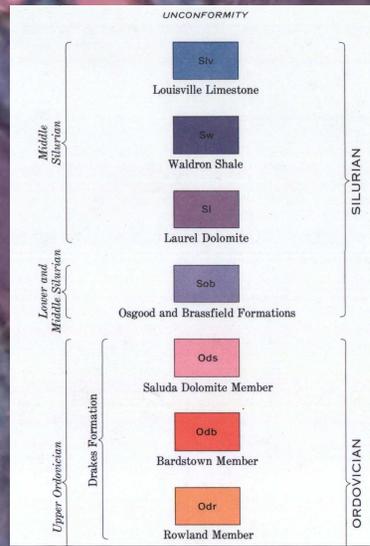
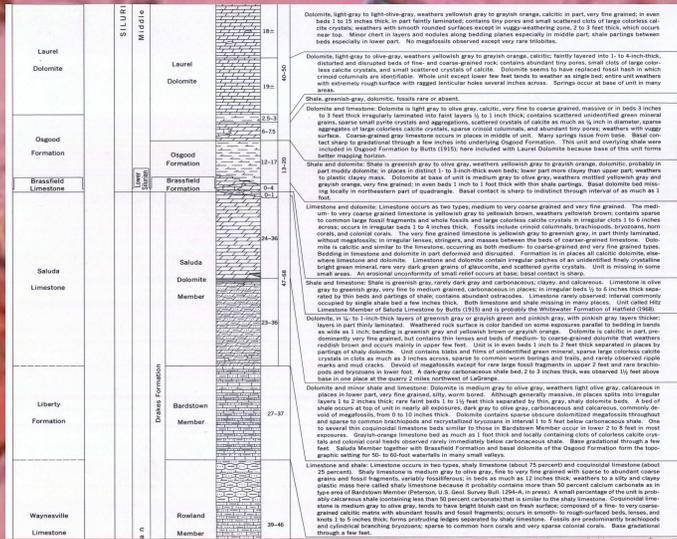
LEGEND

- ROCKLINE SOUNDING
- UNDISTURBED SAMPLE BORING & ROCK CORE
- ALT. 1B SF PLATE GIRDER
- ALT. 1A DS PLATE GIRDER
- ALT. 3C 3 SPAN DS PLATE GIRDER

ITEM NUMBER
5-434.00

Not to Scale

FISCAL COURT		SHEET NO. N/A
COUNTY OLDHAM		DRAWING NO. N/A
CROSSING CSX RAILROAD		
BORING LAYOUT		
PREPARED BY DLZ KENTUCKY, INC.		
201 BRIGHTON PARK BLVD. FRANKFORT, KENTUCKY 40602 (502) 695-2300		



Google earth

feet
meters



800



GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-1</u> Surface Elevation <u>770.8'</u> Total Depth <u>23.0'</u> Location <u>1+41.00 39.0' Lt.</u>		Immediate Water Depth <u>NA</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u> Geologist <u>Kyle Reinhart</u>		Start Date <u>12/30/2014</u> End Date <u>12/30/2014</u> Latitude(83) <u>38.393545</u> Longitude(83) <u>-85.394701</u>		Hole Type <u>core and sample</u> Rig Number <u>CME-45C</u> <u>GQ-277</u> <u>Drake</u>			
Lithology	Description		Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Rock Core		Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
767.8	3.0	Overburden: Stiff to very stiff, reddish brown, FAT CLAY, trace gravel, moist.		1	1.0-2.5	0.6	2-2-6	SPT	Hand Penetrometer Reading (HP) = 2.0 tsf @ 1-2.5 HP = 3.5 tsf @ 3-5
765.3	5.5	Overburden: very stiff to very hard, yellowish brown, FAT CLAY, trace gravel, contains decomposed dolomite fragments, moist, (@5.5' auger refusal).		2	3.5-5.0	0.8	3-19-37	SPT	
762.3	8.5	Dolomite: Light brown, slightly strong, very fine to fine grained, thin to medium, argillaceous, arenaceous, @6.1'-8.4', narrow near vertical fracture.		98 / 98	5.0	5.0	100		
		Dolomite: Gray to dark gray, strong, very fine to fine grained, laminated to thin, argillaceous, arenaceous.		100 / 100	5.0	5.0	100		10.5
				100 / 100	5.0	5.0	100		15.5
750.5	20.3			100 / 100	5.0	5.0	100		20.5
747.8	23.0	Dolomite: Gray to dark gray, strong, very fine to fine grained, laminated to thin, argillaceous, arenaceous, fossiliferous.		100 / 100	2.5	2.5	100		23.0
		(Bottom of Hole 23.0')							

Top of Rock = 5.5' Elevation = 765.3' Base Weathered Rock = 5.5' Elevation = 765.3' RDZ = 5.5' Elevation = 765.3'

Saluda Dolomite Member
Saluda Dolomite Member

GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>					
Hole Number <u>B-2</u> Surface Elevation <u>789.0'</u> Total Depth <u>34.0'</u> Location <u>145+28.04 7.4' Rt.</u>		Immediate Water Depth <u>4.5 (09/04/14)</u> Static Water Depth <u>4.8 (09/05/14)</u> Driller <u>Keith Conrad</u> Geologist <u>Kyle Reinhart</u>		Start Date <u>09/04/2014</u> End Date <u>09/05/2014</u> Latitude(83) <u>38.394632</u> Longitude(83) <u>-85.394774</u>		Hole Type <u>core and sample</u> Rig Number <u>CME 75</u> <u>GQ-277</u> <u>Drake</u>				
Lithology	Description		Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks	
Elevation	Depth	Rock Core		Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)		
788.8	0.2	Overburden: Topsoil - 2".							Hand Penetrometer Reading (HP) = 2.0 tsf @ 1-2.5 HP = 4.5 tsf @ 5-6.5	
		Overburden: Very stiff to hard, brown-gray mottled LEAN CLAY, few fine to coarse sand, trace organic material; damp to moist, [@ 8.5', auger refusal].		1	1.0-2.5	1.5	2-3-5	SPT		
				2	5.0-6.5	1.5	6-7-11	SPT		
780.5	8.5	(Begin Core)								
779.9	9.1	Dolomite: Light brown, strong, very fine grained, thinly bedded.								
		Dolomite: Gray to olive gray, strong, very fine grained, thinly bedded to massive, argillaceous, fossiliferous, [@ 9.2', 11.7', 16.7', 17.5', narrow slightly rough horizontal joints ; @ 10.4', narrow slightly rough horizontal clay filled joint].		100 / 100	5.0	5.0	100		13.5	
				100 / 100	5.0	5.0	100			15
				94 / 94	5.0	5.0	100			18.5
				100 / 100	5.0	5.0	100			23.5
				100 / 100	5.0	5.0	100			25
									28.5	
									33.5	
755.0	34.0			100 / 100	0.5	0.5	100		34.0	
		(Bottom of Hole 34.0')								

Top of Rock = 8.5' Base Weathered Rock = 9.1' RDZ = 9.1'
 Elevation = 780.5' Elevation = 779.9' Elevation = 779.9'

Saluda Dolomite Member
 Saluda Dolomite Member

GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-3a</u> Surface Elevation <u>790.3'</u> Total Depth <u>20.0'</u> Location <u>161+50.00 60.0' Lt.</u>		Immediate Water Depth <u>2.7 (09/04/14)</u> Static Water Depth <u>5.9 (09/05/14)</u> Driller <u>Keith Conrad</u> Geologist <u>Kyle Reinhart</u>		Start Date <u>09/04/2014</u> End Date <u>09/05/2014</u> Latitude(83) <u>38.398675</u> Longitude(83) <u>-85.397121</u>		Hole Type <u>core and sample</u> Rig Number <u>CME 75</u> <u>GQ-277</u> <u>Drake</u>			
Lithology	Description		Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Rock Core		Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
790.1	0.2	Overburden: Topsoil - 2".							Hand Penetrometer Reading = 4.5 tsf @ 1-2.5
		Overburden: Hard, brown FAT CLAY, little fine to coarse sand, trace organic material; damp; @3.5'-4.1', contains dolomite fragments, [@5', auger refusal].		1	1.0-2.5	0.6	6-7-8	SPT	
785.3	5.0	(Begin Core)		2	3.5-4.2	0.0	37-50/0.20'	SPT	
781.2	9.1	Dolomite: Brown and light bluish gray, strong, very fine grained thinly to thickly bedded, argillaceous, [@6.7', 7.0' slightly rough, narrow joints; @8.8'-9.0', clay filled, broken zone].		90 / 90	5.0	5.0	100		10.0
		Dolomite: Olive gray to dark gray, strong, very fine grained, thinly to thickly bedded, argillaceous, fossiliferous, [@12.0'-12.5', broken zone; @12.9', 18.3', 30-degree open, very rough joints].		82 / 82	5.0	5.0	100		15.0
770.3	20.0			100 / 100	5.0	5.0	100		20.0
		(Bottom of Hole 20.0')							25
									30
									35
									40
									45
									50

Top of Rock = 3.5' Base Weathered Rock = 5.0' RDZ = 5.0'
 Elevation = 786.8' Elevation = 785.3' Elevation = 785.3'

Saluda Dolomite Member
 Saluda Dolomite Member

GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-3b</u> Surface Elevation <u>795.4'</u> Total Depth <u>20.5'</u> Location <u>161+48.87 17.7' Rt.</u>		Immediate Water Depth <u>5.1 (09/03/14)</u> Static Water Depth <u>6.8 (09/04/14)</u> Driller <u>Keith Conrad</u> Geologist <u>Kyle Reinhart</u>		Start Date <u>09/03/2014</u> End Date <u>09/04/2014</u> Latitude(83) <u>38.398759</u> Longitude(83) <u>-85.396871</u>		Hole Type <u>core and sample</u> Rig Number <u>CME 75</u> <u>GQ-277</u> <u>Drake</u>			
Lithology	Description		Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Rock Core		Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
795.3	0.1	Overburden: <i>Topsoil - 1.5"</i>							Hand Penetrometer Reading (HP) = 1.5 tsf @ 1-2.5 HP = 4.0 tsf @ 3.5-5
		Overburden: <i>Stiff to very stiff, reddish brown LEAN CLAY, few fine to medium sand, trace coarse sand, trace fine gravel, trace organic material; moist, [@5.5', auger refusal].</i>		1	1.0-2.5	1.3	1-1-3	SPT	
789.9	5.5	(Begin Core)		2	3.5-5.0	1.3	2-3-6	SPT	
		Dolomite: <i>Brown to light bluish gray, strong, very fine grained, very thinly to thinly bedded, argillaceous, [@7.0', 7.3', slightly rough horizontal joints; @8.8'-8.9', low angle, open, slightly rough joints; clay filled zone].</i>		88 / 88	5.0	4.8	96		10.5
782.6	12.8			92 / 92	5.0	4.7	94		15.5
		Dolomite: <i>Greenish gray to dark gray, strong, very fine grained, very thinly to thinly bedded, argillaceous, fossiliferous, [@12.8'-13.2' shale bed; @ 16.4'-16.7', clay filled zone; @17.0', narrow, slightly rough, horizontal clay filled joint].</i>		86 / 86	5.0	4.8	96		20.5
774.9	20.5								
		(Bottom of Hole 20.5')							

Top of Rock = 5.5' Elevation = 789.9' Base Weathered Rock = 5.5' Elevation = 789.9' RDZ = 5.5' Elevation = 789.9'

Saluda Dolomite Member
Saluda Dolomite Member

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>				Project Type: <u>Roadway Railroad Bridge</u>			
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>				Project Manager: <u>Eric Scott</u>			
Hole Number <u>B-4</u>		Immediate Water Depth <u>NA</u>		Start Date <u>09/10/2014</u>		Hole Type <u>sounding</u>			
Surface Elevation <u>764.1'</u>		Static Water Depth <u>NA</u>		End Date <u>09/10/2014</u>		Rig Number <u>CME 750X</u>			
Total Depth <u>8.4'</u>		Driller <u>Larry Bartlett</u>		Latitude(83) <u>38.392920</u>					
Location <u>138+71.82 46.9' Rt.</u>				Longitude(83) <u>-85.394154</u>					
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
763.9	0.1	Topsoil (1.5").							
755.7	8.4	Very dense, brown, rock fragments (Decomposed dolomite).		1	8.0-8.4	0.4	50/0.40'	SPT	
		(Bottom of Hole 8.4') (Refusal @ 8)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>				Project Type: <u>Roadway Railroad Bridge</u>			
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>				Project Manager: <u>Eric Scott</u>			
Hole Number <u>B-5</u>		Immediate Water Depth <u>NA</u>		Start Date <u>09/10/2014</u>		Hole Type <u>sounding</u>			
Surface Elevation <u>768.1'</u>		Static Water Depth <u>NA</u>		End Date <u>09/10/2014</u>		Rig Number <u>CME 750X</u>			
Total Depth <u>7.8'</u>		Driller <u>Larry Bartlett</u>		Latitude(83) <u>38.393542</u>					
Location <u>141+19.03 38.9' Rt.</u>				Longitude(83) <u>-85.394424</u>					
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
767.9	0.2	Topsoil (2").							
760.3	7.8	Very dense, brown, rock fragments (Decomposed dolomite).		1	7.5-7.8	0.2	50/0.30'	SPT	
		(Bottom of Hole 7.8') (Refusal @ 7.5)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-6</u> Surface Elevation <u>787.3'</u> Total Depth <u>9.4'</u> Location <u>145+05.00 30.0' Lt.</u>		Immediate Water Depth <u>NA</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u>		Start Date <u>09/02/2014</u> End Date <u>09/02/2014</u> Latitude(83) <u>38.394552</u> Longitude(83) <u>-85.394889</u>		Hole Type <u>sounding</u> Rig Number <u>CME 75</u>			
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
787.2	0.1	Topsoil (1.5").							
777.9	9.4	Very dense, brown, rock fragments (Decomposed dolomite).		1	8.5-9.4	0.7	27-50/0.40'	SPT	
		(Bottom of Hole 9.4') (Refusal @ 8.5)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u>				
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>			Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-9</u>		Immediate Water Depth <u>NA</u>		Start Date <u>09/03/2014</u>		Hole Type <u>cut profile</u>			
Surface Elevation <u>763.5'</u>		Static Water Depth <u>NA</u>		End Date <u>09/03/2014</u>		Rig Number <u>CME 75</u>			
Total Depth <u>8.9'</u>		Driller <u>Keith Conrad</u>		Latitude(83) <u>38.393211</u>					
Location <u>140+02.74 1.3' Lt.</u>				Longitude(83) <u>-85.394465</u>					
Lithology		Overburden		Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Description		Rock Core	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
762.7	0.8	Asphalt Pavement (10").							
760.0	3.5	Very stiff, brown, damp, lean clay with trace fine gravel, trace organic ((A-6)/(CL) @1'-2.5' HP=3.5 tsf).		1	1.0-2.5	1.5	19-15-6	SPT	
5				2	3.5-5.0	0.8	5-4-4	SPT	5
755.0	8.5	Very stiff, brown, moist, lean clay with trace fine gravel, trace organic ((A-6)/(CL) @3.5'-5.0' HP=4.5 tsf).							
754.7	8.8	Very dense, brown, rock fragments (Decomposed dolomite).		3	8.5-8.9	0.4	50/0.40'	SPT	10
15		(Bottom of Hole 8.9') (Refusal @ 8.5)							15
20									20
25									25
30									30
35									35
40									40
45									45
50									50

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>				Project Type: <u>Roadway Railroad Bridge</u>			
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>				Project Manager: <u>Eric Scott</u>			
Hole Number <u>B-10</u>		Immediate Water Depth <u>NA</u>		Start Date <u>09/03/2014</u>		Hole Type <u>cut profile</u>			
Surface Elevation <u>770.9'</u>		Static Water Depth <u>NA</u>		End Date <u>09/03/2014</u>		Rig Number <u>CME 75</u>			
Total Depth <u>2.4'</u>		Driller <u>Keith Conrad</u>		Latitude(83) <u>38.393741</u>					
Location <u>142+00.00 CL</u>				Longitude(83) <u>-85.394606</u>					
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
770.0	0.8	Asphalt Pavement (10")							
768.5	2.4	Very dense, brown, rock fragments (Decomposed dolomite)		1	1.0-2.4	0.5	37-41-50/0.40'	SPT	
		(Bottom of Hole 2.4') (Refusal @ 0.8)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-11</u> Surface Elevation <u>784.1'</u> Total Depth <u>3.7'</u> Location <u>144+00.00 CL</u>		Immediate Water Depth <u>NA</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u>		Start Date <u>09/03/2014</u> End Date <u>09/04/2014</u> Latitude(83) <u>38.394282</u> Longitude(83) <u>-85.394723</u>		Hole Type <u>cut profile</u> Rig Number <u>CME 75</u>			
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
783.2	0.8	Asphalt Pavement (10").							
780.6	3.5	Stiff, brown, moist, lean clay with trace fine gravel, trace organic ((A-6)/(CL); @1.0'-2.5', HP=1.5 tsf).		1	1.0-2.5	1.2	2-3-4	SPT	
780.4	3.7	Very dense, brown, rock fragments (Decomposed dolomite).		2	3.5-3.7	0.2	50/0.20'	SPT	
		(Bottom of Hole 3.7') (Refusal @ 3.5)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u>				
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>			Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-12</u>		Immediate Water Depth <u>NA</u>		Start Date <u>09/02/2014</u>		Hole Type <u>cut profile</u>			
Surface Elevation <u>789.5'</u>		Static Water Depth <u>NA</u>		End Date <u>09/02/2014</u>		Rig Number <u>CME 75</u>			
Total Depth <u>7.9'</u>		Driller <u>Keith Conrad</u>		Latitude(83) <u>38.394823</u>					
Location <u>146+00.00 CL</u>				Longitude(83) <u>-85.394843</u>					
Lithology		Overburden		Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Description		Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
789.3	0.1	Topsoil (1.5").							
		Very stiff, brown, damp, lean clay with trace organic ((A-6)/(CL); @1.0'-2.5', HP=3.5 tsf, @3.5'-5.0', HP=3.0 tsf).		1	1.0-2.5	1.5	5-3-5	SPT	
				2	3.5-5.0	1.4	9-7-6	SPT	
782.0	7.5	Very dense, brown, rock fragments (Decomposed dolomite).		3	7.5-7.9	0.1	50/0.40'	SPT	
781.6	7.9								
		(Bottom of Hole 7.9') (Refusal @ 7.5)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-13</u> Surface Elevation <u>787.0'</u> Total Depth <u>7.6'</u> Location <u>148+00.00 CL</u>		Immediate Water Depth <u>NA</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u>		Start Date <u>09/02/2014</u> End Date <u>09/02/2014</u> Latitude(83) <u>38.395350</u> Longitude(83) <u>-85.395038</u>		Hole Type <u>cut profile</u> Rig Number <u>CME 75</u>			
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
786.8	0.2	Topsoil (2").							
		Stiff to very stiff, brown, moist, lean clay with trace sand, trace organic ((A-6)/(CL)); @1.0'-2.5', HP=1.5 tsf, @3.5'-5.0', HP=3.0 tsf.).		1	1.0-2.5	1.5	4-6-8	SPT	
				2	3.5-5.0	1.5	4-4-6	SPT	
779.5 779.4	7.5 7.6	Very dense, brown, rock fragments (Decomposed dolomite).		3	7.5-7.6	0.1	50/0.10'	SPT	
		(Bottom of Hole 7.6') (Refusal @ 7.5)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-14</u> Surface Elevation <u>791.3'</u> Total Depth <u>8.8'</u> Location <u>150+00.00 CL</u>		Immediate Water Depth <u>NA</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u>		Start Date <u>09/04/2014</u> End Date <u>09/05/2014</u> Latitude(83) <u>38.395861</u> Longitude(83) <u>-85.395291</u>		Hole Type <u>cut profile</u> Rig_Number <u>CME 75</u>			
Lithology		Overburden		Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Description		Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
791.2	0.1	Topsoil (1.5").							
		Very stiff, brown, damp to moist, lean clay with trace fine gravel, trace organic ((A-6)/(CL); @1.0'-2.5', HP=2.0 tsf @2.0'-3.5', HP=4.0 tsf).		1	1.0-2.5	0.4	3-3-5	SPT	
				2	3.5-5.0	1.1	3-4-5	SPT	
782.8	8.5								
782.5	8.8	Very dense, brown, rock fragments (Decomposed dolomite).		3	8.5-8.8	0.3	50/0.30'	SPT	
		(Bottom of Hole 8.8') (Refusal @ 8.5)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-15</u> Surface Elevation <u>790.0'</u> Total Depth <u>7.4'</u> Location <u>153+69.61 12.1' Lt.</u>		Immediate Water Depth <u>NA</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u>		Start Date <u>09/04/2014</u> End Date <u>09/05/2014</u> Latitude(83) <u>38.396795</u> Longitude(83) <u>-85.395796</u>		Hole Type <u>cut profile</u> Rig_Number <u>CME 75</u>			
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
789.9	0.1	Topsoil (1.5").							
		Very stiff to hard, brown, damp to moist, lean clay with trace organic ((A-6)/(CL); @1.0'-2.5', HP=3.0 tsf, @3.5'-5.0', HP=4.5 tsf).		1	1.0-2.5	0.8	5-7-7	SPT	
				2	3.5-5.0	1.5	9-9-15	SPT	
783.0	7.0								
782.6	7.4	Very dense, brown, rock fragments (Decomposed dolomite).		3	7.0-7.4	0.4	50/0.40'	SPT	
		(Bottom of Hole 7.4') (Refusal @ 7)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u>				
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>			Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-16</u>		Immediate Water Depth <u>NA</u>		Start Date <u>09/03/2014</u>		Hole Type <u>cut profile</u>			
Surface Elevation <u>796.1'</u>		Static Water Depth <u>NA</u>		End Date <u>09/03/2014</u>		Rig Number <u>CME 75</u>			
Total Depth <u>4.4'</u>		Driller <u>Keith Conrad</u>		Latitude(83) <u>38.397872</u>					
Location <u>158+00.96 4.0' Lt.</u>				Longitude(83) <u>-85.396416</u>					
Lithology		Overburden		Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Description		Rock Core	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
795.1	1.0	Asphalt Pavement (12").							
		Stiff, brown, moist, lean clay with little sand, trace organic ((A-6)/(CL); @1.0'-2.5', HP=1.5 tsf).		1	1.0-2.5	0.8	6-1-5	SPT	
792.1	4.0								
791.7	4.4	Very dense, rock fragments (Decomposed dolomite).		2	3.5-4.4	0.9	10-50/0.40'	SPT	
		(Bottom of Hole 4.4') (Refusal @ 4)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>				Project Type: <u>Roadway Railroad Bridge</u>				
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>				Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-17</u>		Immediate Water Depth <u>NA</u>		Start Date <u>09/04/2014</u>		Hole Type <u>cut profile</u>				
Surface Elevation <u>797.1'</u>		Static Water Depth <u>NA</u>		End Date <u>09/04/2014</u>		Rig Number <u>CME 75</u>				
Total Depth <u>2.2'</u>		Driller <u>Keith Conrad</u>		Latitude(83) <u>38.398888</u>						
Location <u>162+00.31 18.9' Rt.</u>				Longitude(83) <u>-85.396935</u>						
Lithology		Description		Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth			Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
796.9	0.1	Topsoil (1.5").								
795.1	2.0	Stiff, brown, moist, lean clay with trace organic			1	1.0-2.2	1.2	1-1-50/0.20'	SPT	
794.9	2.2	((A-6)/(CL); @1.0'-2.5'; HP=1.5 tsf).								
		Very dense, rock fragments (Decomposed dolomite).								
		(Bottom of Hole 2.2') (Refusal @ 2)								

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>				Project Type: <u>Roadway Railroad Bridge</u>			
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>				Project Manager: <u>Eric Scott</u>			
Hole Number <u>B-18</u>		Immediate Water Depth <u>NA</u>		Start Date <u>09/04/2014</u>		Hole Type <u>cut profile</u>			
Surface Elevation <u>821.4'</u>		Static Water Depth <u>NA</u>		End Date <u>09/04/2014</u>		Rig Number <u>CME 75</u>			
Total Depth <u>2.5'</u>		Driller <u>Keith Conrad</u>		Latitude(83) <u>38.399933</u>					
Location <u>166+03.66 32.1' Rt.</u>				Longitude(83) <u>-85.397382</u>					
Lithology		Overburden		Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Description		Rock Core	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
820.9	0.5	Asphalt Pavement (6").							
818.9	2.5	Dense, brown, rock fragments (Decomposed dolomite).		1	1.0-2.5	1.5	12-16-27	SPT	
		(Bottom of Hole 2.5') (Refusal @ 0.5)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-19</u> Surface Elevation <u>828.6'</u> Total Depth <u>3.6'</u> Location <u>168+04.52 5.2' Lt.</u>		Immediate Water Depth <u>NA</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u>		Start Date <u>09/04/2014</u> End Date <u>09/05/2014</u> Latitude(83) <u>38.400443</u> Longitude(83) <u>-85.397657</u>		Hole Type <u>cut profile</u> Rig_Number <u>CME 75</u>			
Lithology		Overburden		Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Description		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	
828.4	0.2	Topsoil (2.5").							
825.1	3.5	Medium stiff, brown, moist, lean clay with trace sand, trace gravel ((A-6)/(CL); @1.0'-2.5', HP=3.0 tsf).		1	1.0-2.5	0.9	7-8-11	SPT	
825.0	3.6	Very dense, rock fragments (decomposed dolomite).		2	3.5-3.6	0.0	50/0.10'	SPT	
		(Bottom of Hole 3.6') (Refusal @ 3.5)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-20</u> Surface Elevation <u>856.3'</u> Total Depth <u>12.4'</u> Location <u>172+00.05 0.6' Lt.</u>		Immediate Water Depth <u>NA</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u>		Start Date <u>12/30/2014</u> End Date <u>12/30/2014</u> Latitude(83) <u>38.401516</u> Longitude(83) <u>-85.397865</u>		Hole Type <u>sample</u> Rig Number <u>CME-45C</u>			
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
853.8	2.5	Stiff, brown, moist, clay ((A-6)/(CL); @1.0'-2.5', HP=1.5 tsf).		1	1.0-2.5	1.1	1-2-4	SPT	
850.3	6.0	Stiff, red, moist, fat clay with rock fragments ((A-7)/(CH); @3.5'-5.0', HP=2.0 tsf).		2	3.5-5.0	1.5	5-4-7	SPT	
844.3	12.0	Very stiff, red, moist, fat clay with rock fragments ((A-7)/(CH); @6.0'-7.5', HP=3.25 tsf, @8.5'-10', HP=3.5 tsf).		3	6.0-7.5	1.3	8-6-11	SPT	
843.9	12.4			4	8.5-10.0	0.8	5-4-8	SPT	
		Very dense, gray, rock fragments (decomposed dolomite).		5	12.0-12.4	0.3	50/0.40'	SPT	
		(Bottom of Hole 12.4') (Refusal @ 12)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-22</u> Surface Elevation <u>856.2'</u> Total Depth <u>13.3'</u> Location <u>170+99.59 262.4' Lt.</u>		Immediate Water Depth <u>NA</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u>		Start Date <u>12/29/2014</u> End Date <u>12/29/2014</u> Latitude(83) <u>38.401131</u> Longitude(83) <u>-85.398705</u>		Hole Type <u>sample</u> Rig_Number <u>CME-45C</u>			
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
		Very stiff, red, moist, fat clay ((A-7)/(CH); @1.0'-2.5', HP=2.5 tsf, @3.5'-5.0', HP=3.75 tsf, @6.0'-7.5', HP=3.0 tsf).		1	1.0-2.5	1.1	2-2-3	SPT	
				2	3.5-5.0	1.0	4-4-5	SPT	
				3	6.0-7.5	1.5	3-4-6	SPT	
847.7	8.5								
		Very stiff, red, moist, fat clay with rock fragments ((A-7)/(CH); @8.5'-10', HP=2.5 tsf).		4	8.5-10.0	0.8	8-8-9	SPT	
843.2	13.0								
842.9	13.3								
		Very dense, brown, rock fragments (decomposed dolomite).		5	13.0-13.3	0.2	50/0.30'	SPT	
		(Bottom of Hole 13.3') (Refusal @ 13)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-23</u> Surface Elevation <u>861.6'</u> Total Depth <u>5.7'</u> Location <u>171+13.00 298.7' Rt.</u>		Immediate Water Depth <u>NA</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u>		Start Date <u>09/10/2014</u> End Date <u>09/10/2014</u> Latitude(83) <u>38.401410</u> Longitude(83) <u>-85.396779</u>		Hole Type <u>sample</u> Rig Number <u>CME 75</u>			
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
859.1	2.5	Soft, black, damp to moist, lean clay with trace sand (Probable FILL, A-6/(CL)).		1	1.0-2.5	0.5	1-1-3	SPT	
856.1	5.5	Stiff to very stiff, brown, damp to moist, fat clay with trace sand (A-7-6/(CH)).		2	3.5-5.0	1.1	3-4-5	SPT	
855.9	5.7	Very dense, brown, rock fragments (Decomposed dolomite).		3	5.5-5.7	0.1	50/0.20'	SPT	
		(Bottom of Hole 5.7') (Refusal @ 5.5)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u>				
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>			Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-24</u>		Immediate Water Depth <u>NA</u>		Start Date <u>09/03/2014</u>		Hole Type <u>sample</u>			
Surface Elevation <u>752.0'</u>		Static Water Depth <u>NA</u>		End Date <u>09/03/2014</u>		Rig Number <u>CME 75</u>			
Total Depth <u>8.7'</u>		Driller <u>Keith Conrad</u>		Latitude(83) <u>38.391976</u>					
Location <u>44+00.00 7.0' Lt.</u>				Longitude(83) <u>-85.396108</u>					
Lithology		Overburden		Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Description		Rock Core	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
751.2	0.8	Asphalt Pavment (10").							
750.8	1.2	Rock fragments (DGA - 4").							
		Stiff, brown, moist, fat clay with trace sand (A-7-6/(CH)).		1	2.0-4.0	1.4		ST	
743.5	8.5								
743.3	8.7	Very dense, gray, rock fragments (Decomposed dolomite).		2	8.5-8.7	0.2	50/0.20'	SPT	
		(Bottom of Hole 8.7') (Refusal @ 8.5)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-25</u> Surface Elevation <u>754.1'</u> Total Depth <u>8.3'</u> Location <u>48+00.00 7.0' Rt.</u>		Immediate Water Depth <u>NA</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u>		Start Date <u>09/03/2014</u> End Date <u>09/03/2014</u> Latitude(83) <u>38.392345</u> Longitude(83) <u>-85.394792</u>		Hole Type <u>sample</u> Rig Number <u>CME 75</u>			
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
753.2	0.9	Asphalt Pavement (11")							
752.9	1.2	Rock fragments (DGA - 3")							
		Hard, brown, damp, lean clay with trace gravel ((A-6)/(CL); @1.0'-2.5', HP=4.5 tsf.).		1	2.0-3.5	1.5	5-5-6	SPT	
746.1	8.0								
745.8	8.3	Very dense, gray, rock fragments (Decomposed limestone).		2	8.0-8.3	0.2	50/0.30'	SPT	
		(Bottom of Hole 8.3') (Refusal @ 8)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-26</u> Surface Elevation <u>756.2'</u> Total Depth <u>9.4'</u> Location <u>52+00.00 7.0' Lt.</u>		Immediate Water Depth <u>NA</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u>		Start Date <u>09/03/2014</u> End Date <u>09/03/2014</u> Latitude(83) <u>38.392785</u> Longitude(83) <u>-85.393512</u>		Hole Type <u>sample</u> Rig Number <u>CME 75</u>			
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
755.6	0.6	Asphalt Pavement (7")							
755.1	1.0	Rock fragments (DGA - 5")							
		Very stiff, brown and gray, damp, sandy lean clay with trace fine gravel, trace organic ((A-6)/(CL); @4.0'-5.5', HP=4.5 tsf).		1	2.0-4.0	2.0		ST	
				2	4.0-5.5	1.1	3-8-20	SPT	
747.7	8.5								
746.8	9.4	Very dense, rock fragments (Decomposed limestone).		3	8.5-9.4	0.9	20-50/0.40'	SPT	
		(Bottom of Hole 9.4') (Refusal @ 8.5)							

DRILLER'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-27</u> Surface Elevation <u>758.5'</u> Total Depth <u>4.9'</u> Location <u>57+00.00 7.0' Rt.</u>		Immediate Water Depth <u>NA</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u>		Start Date <u>09/03/2014</u> End Date <u>09/03/2014</u> Latitude(83) <u>38.393254</u> Longitude(83) <u>-85.391872</u>		Hole Type <u>sample</u> Rig Number <u>CME 75</u>			
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
757.7	0.8	Asphalt Pavement (10").							
757.3	1.2	Rock fragments (DGA - 4").							
		Stiff, brown and gray, damp, silty sand with trace fine gravel ((A-6)/(SM); @1.5'-3.0', HP=2.0 tsf).		1	1.5-3.0	0.8	14-3-4	SPT	
754.0	4.5								
753.6	4.9	Very dense, brown, rock fragments (Decomposed dolomite).		2	4.5-4.9	0.3	50/0.40'	SPT	
		(Bottom of Hole 4.9') (Refusal @ 4.5)							

GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>	<u>Oldham - Allen Lane</u> <u>Allen Lane</u>	Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>
Item Number: <u>5-434.00</u>		

Hole Number <u>B-28</u>	Immediate Water Depth <u>NA</u>	Start Date <u>09/09/2014</u>	Hole Type <u>sounding</u>
Surface Elevation <u>854.7'</u>	Static Water Depth <u>NA</u>	End Date <u>09/09/2014</u>	Rig Number <u>CME 750X</u>
Total Depth <u>15.3'</u>	Driller <u>Larry Bartlett</u>	Latitude(83) <u>38.401029</u>	<u>GQ-</u>
Location <u>170+32.37 77.2' Lt.</u>	Geologist <u>Kyle Reinhart</u>	Longitude(83) <u>-85.398030</u>	

Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
5									5
10									10
15				1	15.0-15.3	0.3	50/0.30'	SPT	15
20		(Bottom of Hole 15.3') (Refusal @ 15)							20
25									25
30									30
35									35
40									40
45									45
50									50

Top of Rock = 15.0'
 Elevation = 839.7'

GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>		Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>					
Hole Number <u>B-30</u> Surface Elevation <u>850.2'</u> Total Depth <u>40.0'</u> Location <u>169+63.00 70.0' Lt.</u>		Immediate Water Depth <u>10.7 (09/09/14)</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u> Geologist <u>Kyle Reinhart</u>		Start Date <u>09/09/2014</u> End Date <u>09/09/2014</u> Latitude(83) <u>38.400845</u> Longitude(83) <u>-85.397967</u>		Hole Type <u>core and sample</u> Rig Number <u>CME 75</u> <u>GQ-1075</u> <u>Laurel</u>			
Lithology		Overburden		Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Description		Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
850.1	0.1	Overburden: Topsoil - 1"							Hand Penetrometer Reading (HP) = 4.5 tsf @ 1-2.5 HP = 4.0 tsf @ 3.5-5 HP = 3.5 tsf @ 6-7.5
847.7	2.5	Overburden: Hard, brown LEAN CLAY, some fine to coarse sand, damp.		1	1.0-2.5	1.5	12-7-6	SPT	
844.2	6.0	Overburden: Very stiff to hard, reddish-brown FAT CLAY, trace fine to coarse sand, trace organic, damp to moist.		2	3.5-5.0	1.3	4-5-5	SPT	
841.7	8.5	Overburden: Very stiff, reddish-brown FAT CLAY, trace fine to coarse sand, trace organic, moist.		3	6.0-7.5	1.5	5-3-5	SPT	
840.2	10.0	Overburden: Brown rock (dolomite) fragments, [<u>@10'</u> auger refusal]. (Begin Core)		4	8.5-9.3	0.8	38-50/0.30'	SPT	10
835.4	14.8	Dolomite: Brown and light gray, strong, fine to coarse grained, thinly to very thinly bedded, vuggy, fossiliferous, [<u>@10.0'-10.8'</u> , lost recovery in broken zone; <u>@10.8'-12.1'</u> , broken zone; <u>@12.7', 13.6', 14.2', 14.6', 14.7'</u> , low angle, iron stained, narrow, slightly rough horizontal joints].		38 / 38	5.0	1.9	38		15.0 Uc=1,720 psi, Unit Wt.=144 pcf @ 13.5-13.85
833.4	16.8	Dolomite: Gray, strong, very fine to fine grained, thinly bedded, argillaceous, few pinhole vugs, [<u>@16.3'</u> , slightly rough narrow horizontal joint].		88 / 88	5.0	4.4	88		
830.0	20.2	Shale: Gray, slightly strong, (nondurable Class II), [<u>@16.8'-16.9'</u> , clay filled zone; <u>@17.1', 17.9', 18.5', 19.5'</u> , clay filled, tight, slightly rough horizontal joints; <u>@19.7'-19.8'</u> , broken zone;].						64@19 (4)	20.0
822.8	27.4	Dolomite: Gray, strong, thinly to thickly bedded, argillaceous, vuggy, [<u>@23.7'-24.1'</u> , iron stained, narrow, very rough vertical joint; <u>@22.5', 22.8'</u> , clay filled, tight, slightly rough horizontal joints; <u>@25.2'</u> , slightly rough, narrow, horizontal joints].		98 / 98	10.0	9.8	98		25 Uc=12,743 psi, Unit Wt.=162 pcf @ 22.9-23.4
811.5	38.7	Dolomite: Gray, strong, thinly to thickly bedded, argillaceous, [<u>@35.8'</u> , clay filled, tight, slightly rough horizontal joints; <u>@29.5'</u> , slightly rough, narrow, horizontal joints].		95 / 95	10.0	9.5	95	99@30 (5)	30.0
810.2	40.0	Shale: Gray, slightly to moderately strong; (nondurable based on visual classification), [<u>@38.8', 39.5', 39.8'</u> , clay filled, tight, slightly rough horizontal joints, <u>@38.8'-39.2'</u> , highly weathered zone w clay filling].							40.0 Uc=12,716 psi, Unit Wt.=165 pcf @ 36.15-36.55
		(Bottom of Hole 40.0')							45

Top of Rock = 8.5' Elevation = 841.7' Base Weathered Rock = 10.0' RDZ = 10.0' ABC is 20 tsf @ 10.0' (840.2') Elevation = 840.2'

Laurel Dolomite
Laurel Dolomite

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-32</u> Surface Elevation <u>854.7'</u> Total Depth <u>40.0'</u> Location <u>170+43.21 41.7' Lt.</u>		Immediate Water Depth <u>3.9 (09/09/14)</u> Static Water Depth <u>NA</u> Driller <u>Larry Bartlett</u> Geologist <u>Kyle Reinhart</u>		Start Date <u>09/09/2014</u> End Date <u>09/09/2014</u> Latitude(83) <u>38.401074</u> Longitude(83) <u>-85.397914</u>		Hole Type <u>core and sample</u> Rig Number <u>CME 750X</u> <u>GQ-1075</u> <u>Laurel</u>			
Lithology	Description		Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
854.5	0.1	Overburden: Topsoil - 1.5".							Hand Penetrometer Reading (HP) = 3.5 tsf @ 1-2.5 HP = 4.5 tsf @ 3.5-5 HP = 4.5 tsf @ 6-7.5 HP = 4.5 tsf @ 8.5-10
848.7	6.0	Overburden: Very stiff to hard, reddish brown FAT CLAY, trace fine to medium sand, trace organic; damp to moist.		1	1.0-2.5	1.0	3-4-5	SPT	
846.2	8.5	Overburden: Hard, reddish brown FAT CLAY, trace fine to medium sand, trace organic; damp.		2	3.5-5.0	1.3	5-7-8	SPT	
843.7	11.0	Overburden: Hard, reddish brown FAT CLAY, trace fine to medium sand, trace organic; damp to moist.		3	6.0-7.5	1.3	4-7-10	SPT	
839.7	15.0	Overburden: Brown rock (dolomite) fragments, [@15', auger refusal].		4	8.5-10.0	1.5	8-5-10	SPT	
		(Begin Core)		5	11.0-12.5	0.6	1-2-47	SPT	
				6	13.5-13.8	0.2	50/0.30'	SPT	
		Dolomite: Brown to gray, strong, fine to coarse grained, very thinly to thinly bedded, vuggy, fossiliferous.; [@15'-20', lost recovery in broken zones; @21.3';21.8';22.8';23.4';25.9', open, iron stained, very rough horizontal joints].		0 / 0	5.0	0.8	15		Uc=2,579 psi, Unit Wt.=149 pcf @ 21.4-21.8
				28 / 28	5.0	3.6	72		
		Dolomite: Gray, strong, very fine grained, thinly bedded, argillaceous, pin hole vugs, [@ 27'-27.5', 28.2-29.3' olive to dark gray calcareous shale bands; @26';26.1';26.5';26.9';28';28.1';28.3';28.5';29', slightly rough horizontal joints].		74 / 74	5.0	5.0	100		Uc=15,748, Unit Wt.=167 pcf @ 30.05-30.45
		Dolomite: Gray, strong, very fine grained, very thinly to thickly bedded, argillaceous, [@31.1';33.7';36.4';36.8';39', narrow, slightly rough horizontal joints; @31.8';32.1', 60-degree tight, slightly rough joint].		94 / 94	5.0	5.0	100		
		Dolomite: Gray, strong, very fine grained, very thin to thinly bedded, argillaceous.		100 / 100	5.0	5.0	100		
		Shale: Gray, strong, calcareous (nondurable based on visual classification).							
		Dolomite: Gray, strong, very fine grained, laminated to thinly bedded, argillaceous.							
		(Bottom of Hole 40.0')							

Top of Rock = 11.0' Elevation = 843.7' Base Weathered Rock = 20.0' RDZ = 20.0' ABC is 20 tsf @ 20.0' (834.7') Elevation = 834.7'

Laurel Dolomite
Laurel Dolomite

GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>				Project Type: <u>Roadway Railroad Bridge</u>			
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>				Project Manager: <u>Eric Scott</u>			
Hole Number <u>B-32b</u>		Immediate Water Depth <u>NA</u>		Start Date <u>09/10/2014</u>		Hole Type <u>sounding</u>			
Surface Elevation <u>854.7'</u>		Static Water Depth <u>NA</u>		End Date <u>09/10/2014</u>		Rig Number <u>CME 750X</u>			
Total Depth <u>19.6'</u>		Driller <u>Larry Bartlett</u>		Latitude(83) <u>38.401074</u>		<u>GQ-</u>			
Location <u>170+43.21 41.7' Lt.</u>		Geologist <u>Kyle Reinhart</u>		Longitude(83) <u>-85.397914</u>					
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
5									5
10									10
15									15
20				1	19.5-19.6	0.1	50/0.10'	SPT	20
25		(Bottom of Hole 19.6') (Refusal @ 19.5)							25
30									30
35									35
40									40
45									45
50									50
Top of Rock = 19.5' Elevation = 835.2'									

GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>				Project Type: <u>Roadway Railroad Bridge</u>			
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>				Project Manager: <u>Eric Scott</u>			
Hole Number <u>B-34</u>		Immediate Water Depth <u>NA</u>		Start Date <u>09/09/2014</u>		Hole Type <u>sounding</u>			
Surface Elevation <u>849.9'</u>		Static Water Depth <u>NA</u>		End Date <u>09/09/2014</u>		Rig Number <u>CME 75</u>			
Total Depth <u>11.2'</u>		Driller <u>Keith Conrad</u>		Latitude(83) <u>38.400888</u>		<u>GQ-</u>			
Location <u>169+73.00 33.0' Lt.</u>		Geologist <u>Kyle Reinhart</u>		Longitude(83) <u>-85.397845</u>					
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
5									5
10									10
15		(Bottom of Hole 11.2') (Refusal @ 11)		1	11.0-11.2	0.2	50/0.20'	SPT	15
20									20
25									25
30									30
35									35
40									40
45									45
50									50
Top of Rock = 11.0' Elevation = 838.9'									

GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>				Project Type: <u>Roadway Railroad Bridge</u>			
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>				Project Manager: <u>Eric Scott</u>			
Hole Number <u>B-35</u>		Immediate Water Depth <u>8.3 (09/04/14)</u>		Start Date <u>09/04/2014</u>		Hole Type <u>sounding</u>			
Surface Elevation <u>846.0'</u>		Static Water Depth <u>4.8 (09/05/14)</u>		End Date <u>09/05/2014</u>		Rig Number <u>CME 75</u>			
Total Depth <u>10.7'</u>		Driller <u>Keith Conrad</u>		Latitude(83) <u>38.400784</u>		<u>GQ-</u>			
Location <u>169+32.30 18.1' Lt.</u>		Geologist <u>Kyle Reinhart</u>		Longitude(83) <u>-85.397772</u>					
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
5									5
10									10
15		(Bottom of Hole 10.7') (Refusal @ 10.5)		1	10.5-10.7	0.1	50/0.20'	SPT	15
20									20
25									25
30									30
35									35
40									40
45									45
50									50
Top of Rock = 10.5' Elevation = 835.5'									

GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u>				
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>			Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-36</u>		Immediate Water Depth <u>NA</u>		Start Date <u>09/09/2014</u>		Hole Type <u>sounding</u>			
Surface Elevation <u>855.4'</u>		Static Water Depth <u>NA</u>		End Date <u>09/10/2014</u>		Rig Number <u>CME 750X</u>			
Total Depth <u>13.9'</u>		Driller <u>Larry Bartlett</u>		Latitude(83) <u>38.401181</u>		<u>GQ-</u>			
Location <u>170+69.41 39.9' Rt.</u>		Geologist <u>Kyle Reinhart</u>		Longitude(83) <u>-85.397647</u>					
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
5									5
10									10
15				1	13.5-13.9	0.4	50/0.40'	SPT-	15
20		(Bottom of Hole 13.9') (Refusal @ 13.5)							20
25									25
30									30
35									35
40									40
45									45
50									50
Top of Rock = 13.5' Elevation = 841.9'									

GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>				Project Type: <u>Roadway Railroad Bridge</u>			
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>				Project Manager: <u>Eric Scott</u>			
Hole Number <u>B-37</u>		Immediate Water Depth <u>NA</u>		Start Date <u>09/09/2014</u>		Hole Type <u>sounding</u>			
Surface Elevation <u>855.9'</u>		Static Water Depth <u>NA</u>		End Date <u>09/09/2014</u>		Rig Number <u>CME 750X</u>			
Total Depth <u>15.4'</u>		Driller <u>Larry Bartlett</u>		Latitude(83) <u>38.401151</u>		<u>GQ-</u>			
Location <u>170+59.24 34.7' Rt.</u>		Geologist <u>Kyle Reinhart</u>		Longitude(83) <u>-85.397660</u>					
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
				1	14.5-15.4	0.8	37-50/0.40'	SPT	
		(Bottom of Hole 15.4') (Refusal @ 14.5)							

Top of Rock = 14.5'
 Elevation = 841.4'

GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-39</u> Surface Elevation <u>849.1'</u> Total Depth <u>40.0'</u> Location <u>169+94.00 40.0' Rt.</u>		Immediate Water Depth <u>8.5 (09/09/14)</u> Static Water Depth <u>NA</u> Driller <u>Keith Conrad</u> Geologist <u>Kyle Reinhart</u>		Start Date <u>09/09/2014</u> End Date <u>09/09/2014</u> Latitude(83) <u>38.400976</u> Longitude(83) <u>-85.397605</u>			Hole Type <u>core and sample</u> Rig Number <u>CME 75</u> <u>GQ-1075</u> <u>Laurel</u>		
Lithology	Description		Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth	Rock Core		Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
849.0	0.1	Overburden: Topsoil - 2".							Hand Penetrometer Reading (HP) = 3.5 tsf @ 1-2.5 HP = 1.5 tsf @ 3.5-5
		Overburden: Stiff to very stiff, reddish brown FAT CLAY, trace fine to medium sand, trace organic; moist.		1	1.0-2.5	1.0	1-3-5	SPT	
843.1	6.0			2	3.5-5.0	1.2	2-3-5	SPT	
		Overburden: Brown rock (dolomite) fragments, [@10', auger refusal].		3	6.0-7.5	1.4	3-5-15	SPT	
839.1	10.0	(Begin Core)		4	8.5-8.8	0.2	50/0.30'	SPT	
835.2	13.9	Dolomite: Brown, strong, fine to coarse grained, very thinly to thinly bedded, argillaceous, vuggy, fossiliferous, [@10'-10.6', lost recovery in broken zone; @10.6'-12', 12.2'-12.5', broken zones].		40 / 40	5.0	4.4	88		Uc=3,518 psi, Unit Wt.=148 pcf @ 12.65-13
833.5	15.6	Dolomite: Gray, strong, very fine grained, thinly to thickly bedded, argillaceous, [@14.3'-14.4', broken zone, @15'-15.1', lost recovery in broken zone].							
831.1	18.0	Shale: Dark gray, moderately strong, (nondurable Class II), [@15.7', 15.9', 16', 17.2', slightly rough, narrow, clay filled horizontal joints, @17.5'-17.6', broken zone].		84 / 84	5.0	4.8	96	54@17 (2)	
823.3	25.8	Dolomite: Light to dark gray, strong, very fine grained, thinly to thickly bedded, argillaceous, pin hole vugs, [@21.5', 21.7', 22.9', slightly rough, narrow clay filled horizontal joints].		100 / 100	10.0	10.0	100		Uc=7,676 psi, Unit Wt.=159 pcf @ 20-20.4
811.6	37.5	Dolomite: Light to dark gray, strong, very fine grained, laminated to thinly bedded, argillaceous.						95@26 (5)	Shale reclassified as Dolomite @ 26.3-27.5
809.1	40.0	Shale: Dark gray, moderately strong, thinly laminated, calcareous; (nondurable based on visual classification), [@37.7'-38.4', clay filled zone. @38.9'-39.1', broken zone].		98 / 98	10.0	10.0	100		Uc=7,579 psi, Unit Wt.=166 pcf @ 31-31.4
		(Bottom of Hole 40.0')							

Top of Rock = 6.0' Base Weathered Rock = 10.0' RDZ = 10.0' ABC is 20 tsf @ 10.0' (839.1')
 Elevation = 843.1' Elevation = 839.1' Elevation = 839.1'

Laurel Dolomite
 Laurel Dolomite

GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>				Project Type: <u>Roadway Railroad Bridge</u>			
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>				Project Manager: <u>Eric Scott</u>			
Hole Number <u>B-40</u>		Immediate Water Depth <u>5.2 (09/04/14)</u>		Start Date <u>09/04/2014</u>		Hole Type <u>sounding</u>			
Surface Elevation <u>843.7'</u>		Static Water Depth <u>3.7 (09/05/14)</u>		End Date <u>09/05/2014</u>		Rig Number <u>CME 75</u>			
Total Depth <u>6.8'</u>		Driller <u>Keith Conrad</u>		Latitude(83) <u>38.400848</u>		<u>GQ-</u>			
Location <u>169+45.30 49.1' Rt.</u>		Geologist <u>Kyle Reinhart</u>		Longitude(83) <u>-85.397547</u>					
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
				1	6.5-6.8	0.1	50/0.30'	SPT	
		(Bottom of Hole 6.8') (Refusal @ 6.5)							
5									5
10									10
15									15
20									20
25									25
30									30
35									35
40									40
45									45
50									50
Top of Rock = 6.5' Elevation = 837.2'									

GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>		<u>Oldham - Allen Lane</u> <u>Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-41</u> Surface Elevation <u>856.1'</u> Total Depth <u>40.0'</u> Location <u>170+68.91 72.4' Rt.</u>		Immediate Water Depth <u>NA</u> Static Water Depth <u>NA</u> Driller <u>Larry Bartlett</u> Geologist <u>Kyle Reinhart</u>		Start Date <u>09/10/2014</u> End Date <u>09/10/2014</u> Latitude(83) <u>38.401193</u> Longitude(83) <u>-85.397535</u>		Hole Type <u>core and sample</u> Rig Number <u>CME 750X</u> <u>GQ-1075</u> <u>Laurel</u>			
Lithology	Description		Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
856.0	0.1	Overburden: Topsoil - 1.5"							
852.6	3.5	Overburden: Medium dense, brown to dark brown SILT with fine to coarse sand, little clay, trace fine gravel, trace organic; damp, [Probable Fill].		1	1.0-2.5	0.8	6-8-9	SPT	Hand Penetrometer Reading (HP) = 4.5 tsf @ 3.5-5 HP = 4.5 tsf @ 6-7.5 HP = 4.0 tsf @ 8.5-10 HP = 1.5 tsf @ 11-12.5
5		Overburden: Hard, reddish brown FAT CLAY, little fine to coarse sand, trace fine gravel, trace organic, damp to moist, [@11'-12.5', stiff].		2	3.5-5.0	1.0	10-14-12	SPT	
10				3	6.0-7.5	0.5	3-7-6	SPT	
				4	8.5-10.0	0.9	2-5-7	SPT	
842.6	13.5			5	11.0-12.5	0.7	2-4-6	SPT	
15		Overburden: Brown rock (dolomite) fragments, [@17', auger refusal]. (Begin Core)		6	13.5-13.9	0.4	50/0.40'	SPT	
839.1	17.0								Uc=3,341 psi, Unit Wt.=154 pcf @ 17.2-17.6
20		Dolomite: Brown to gray, strong, fine to coarse grained, thinly bedded, vuggy, [@17.6'; 17.9', 20.1', 20.5'; 22.8', open, slightly rough horizontal joints; @19.1'-19.3'; 21.1'-21.5', broken zones].		82 / 82	5.0	5.0	100		
833.3	22.8								
25		Dolomite: Gray, strong, fine to very fine grained, thinly bedded, argillaceous, [@23.7', 23.9', slightly rough narrow horizontal joints].		96 / 96	5.0	5.0	100		
830.6	25.5								
827.4	28.7	Shale: Dark gray, moderately strong, (nondurable Class I), [@25.4'-25.5'; 28.3'-28.7', broken zones, @27.2'; 27.3', tight, narrow, slightly rough horizontal joints].						80@28 (3)	27.0
30		Dolomite: Gray to dark gray, strong, very fine to fine grained, thinly bedded, argillaceous, pin hole vugs, [@30', 30.2', 30.6'; 31.2', 31.4', tight, narrow, slightly rough horizontal joints, @33.4' 25-degree joint].		90 / 90	10.0	10.0	100		Uc=10,548 psi, Unit Wt.=164 pcf @ 29.5-29.95
821.8	34.3								
35		Dolomite: Gray to dark gray, strong, very fine to fine grained, thinly bedded, argillaceous, [@39.5'-40', broken zones].		100 / 100	3.0	3.0	100		
816.1	40.0								37.0
45		(Bottom of Hole 40.0')							
50									

Top of Rock = 13.5' Elevation = 842.6' Base Weathered Rock = 17.0' Elevation = 839.1' RDZ = 17.0' ABC is 20 tsf @ 17.0' (839.1') Elevation = 839.1'

Laurel Dolomite
 Laurel Dolomite

GEOLOGIST'S SUBSURFACE LOG

Project ID: <u>0631-000602</u>		<u>Oldham - Allen Lane</u>			Project Type: <u>Roadway Railroad Bridge</u>				
Item Number: <u>5-434.00</u>		<u>Allen Lane</u>			Project Manager: <u>Eric Scott</u>				
Hole Number <u>B-43</u>		Immediate Water Depth <u>NA</u>		Start Date <u>09/10/2014</u>			Hole Type <u>sounding</u>		
Surface Elevation <u>849.8'</u>		Static Water Depth <u>NA</u>		End Date <u>09/10/2014</u>			Rig Number <u>CME 75</u>		
Total Depth <u>10.3'</u>		Driller <u>Keith Conrad</u>		Latitude(83) <u>38.401016</u>			<u>GQ-</u>		
Location <u>170+03.00 75.0' Rt.</u>		Geologist <u>Kyle Reinhart</u>		Longitude(83) <u>-85.397490</u>					
Lithology		Description	Overburden	Sample No.	Depth (ft)	Rec. (ft)	SPT Blows	Sample Type	Remarks
Elevation	Depth		Rock Core	Std/Ky RQD	Run (ft)	Rec (ft)	Rec (%)	SDI (JS)	
5									5
10				1	10.0-10.3	0.1	50/0.30'	SPT	10
15		(Bottom of Hole 10.3') (Refusal @ 10)							15
20									20
25									25
30									30
35									35
40									40
45									45
50									50
Top of Rock = 10.0' Elevation = 839.8'									

Drilling Firm: DLZ
 For: Division of Structural Design
 Geotechnical Branch

Summary of Rock Soundings

Project ID: <u>0631-000602</u> Item Number: <u>5-434.00</u>				County: <u>Oldham</u> Route: <u>Allen Lane</u>				Project Type: <u>Roadway Railroad Bridge</u> Project Manager: <u>Eric Scott</u>		
Hole Number	Method	Latitude(83)	Longitude(83)	Station	Offset (ft)	Surface Elevation (ft)	Hole Depth (ft)	Refusal Depth / Elevation (ft)	Refusal Lithology	Notes
B-4	auger	38.392920	-85.394154	138+71.82	46.9' Rt.	764.1	8.4	8.0 / 756.1	weathered dolomite	
B-5	auger	38.393542	-85.394424	141+19.03	38.9' Rt.	768.1	7.8	7.5 / 760.6	weathered dolomite	
B-6	auger	38.394552	-85.394889	145+05.00	30.0' Lt.	787.3	9.4	8.5 / 778.8	weathered dolomite	
B-7	auger	38.395093	-85.395066	147+12.99	37.8' Lt.	789.4	7.3	7.0 / 782.4	weathered dolomite	
B-35	auger	38.400784	-85.397772	169+32.30	18.1' Lt.	846.0	10.7	10.5 / 835.5	weathered dolomite	
B-40	auger	38.400848	-85.397547	169+45.30	49.1' Rt.	843.7	6.8	6.5 / 837.2	weathered dolomite	
B-34	auger	38.400888	-85.397845	169+73.00	33.0' Lt.	849.9	11.2	11.0 / 838.9	weathered dolomite	
B-43	auger	38.401016	-85.397490	170+03.00	75.0' Rt.	849.8	10.3	10.0 / 839.8	weathered dolomite	
B-28	auger	38.401029	-85.398030	170+32.37	77.2' Lt.	854.7	15.3	15.0 / 839.7	weathered dolomite	
B-32b	auger	38.401074	-85.397914	170+43.21	41.7' Lt.	854.7	19.6	19.5 / 835.2	weathered dolomite	
B-31	auger	38.401106	-85.397874	170+52.90	28.6' Lt.	854.5	12.8	12.5 / 842.0	weathered dolomite	
B-37	auger	38.401151	-85.397660	170+59.24	34.7' Rt.	855.9	15.4	14.5 / 841.4	weathered dolomite	
B-36	auger	38.401181	-85.397647	170+69.41	39.9' Rt.	855.4	13.9	13.5 / 841.9	weathered dolomite	

APPENDIX II

Summary of Laboratory Test Results
Laboratory Testing Results

Summary of Laboratory Test Results - Index Properties

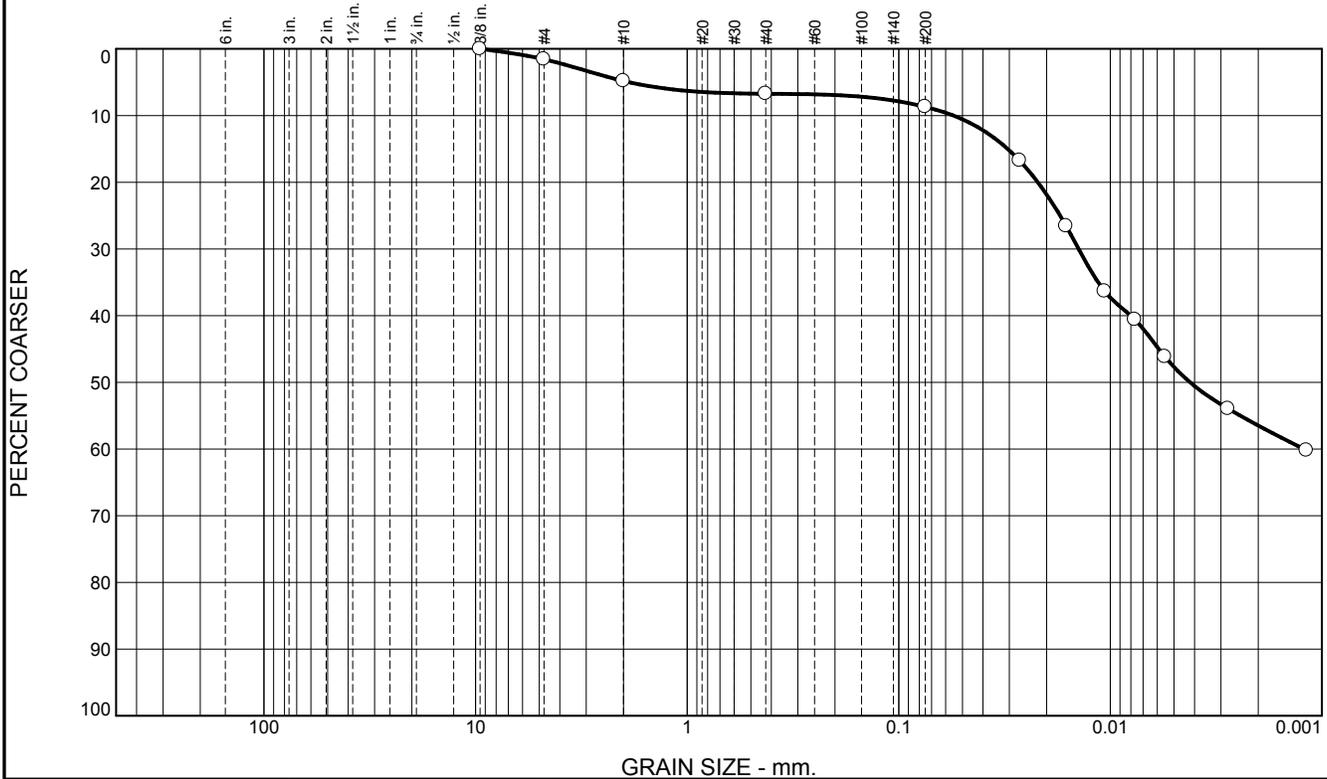
Boring Number	Sample Number	Depth (feet)	USCS Class.	AASHTO Class.	N Value	NG60 Value	% AGG	% C. Sand	% M. Ssand	% F. Sand	% Silt	% Clay	LL	PL	PI	Moisture Content %		
B-1	S-1	1			8	10												
B-1	S-2	3.5			56	71												
B-2	S-1	1	CL	A-6(17)	8	11	0	0.3	2.1	2	66.2	29.4	37	20	17	22.4		
B-2	S-2	5	-	-	18	24	-	-	-	-	-	-	-	-	-	24.5		
B-3a	S-1	1	CH	A-7-6(28)	15	20	0	8	3.2	3.2	35.6	50	58	29	29	22.67		
B-3a	S-2	3.5	-	-	SR	SR	-	-	-	-	-	-	-	-	-	18.48		
B-3b	S-1	1	CL	A-6(17)	4	5	0.5	0.6	2.3	4.2	58.1	34.3	38	20	18	24.96		
B-3b	S-2	3.5	-	-	9	12	-	-	-	-	-	-	-	-	-	27.13		
B-6	S-1	8.5			50	68												
B-7	S-1	7			50	68												
B-8	S-1	1	-	-	13	14	-	-	-	-	-	-	-	-	-	14.48		
B-8	S-2	3.5	-	-	34	38	-	-	-	-	-	-	-	-	-	15.91		
B-9	S-1	1	-	-	21	28	-	-	-	-	-	-	-	-	-	12.69		
B-9	S-2	3.5	-	-	8	11	-	-	-	-	-	-	-	-	-	31.98		
B-10	S-1	1			91	123												
B-11	S-1	1	-	-	7	9	-	-	-	-	-	-	-	-	-	26.18		
B-12	S-1	1	-	-	8	11	-	-	-	-	-	-	-	-	-	18.54		
B-12	S-2	3.5	-	-	13	18	-	-	-	-	-	-	-	-	-	18.54		
B-13	S-1	1	-	-	14	19	-	-	-	-	-	-	-	-	-	23.33		
B-13	S-2	3.5	-	-	10	14	-	-	-	-	-	-	-	-	-	25.28		
B-14	S-1	1	-	-	8	11	-	-	-	-	-	-	-	-	-	20.06		
B-14	S-2	3.5	-	-	9	12	-	-	-	-	-	-	-	-	-	26.29		
B-15	S-1	1	-	-	14	19	-	-	-	-	-	-	-	-	-	22.62		
B-15	S-2	3.5	-	-	24	32	-	-	-	-	-	-	-	-	-	18.75		
B-16	S-1	1	-	-	6	8	-	-	-	-	-	-	-	-	-	23.81		
B-17	S-1	1	-	-	SR	SR	-	-	-	-	-	-	-	-	-	25.64		
B-18	S-1	1			43	58												
B-19	S-1	1	-	-	19	26	-	-	-	-	-	-	-	-	-	19.82		
B-20	S-1	1			6	8												
B-20	S-2	3.5			11	14												
B-20	S-3	6			17	22												
B-20	S-4	8.5			12	15												
B-21	S-1	1			7	9												
B-21	S-2	3.5			13	17												
B-21	S-3	6			17	22												
B-21	S-4	8.5			23	29												
B-22	S-1	1			5	6												
B-22	S-2	3.5			9	11												
B-22	S-3	6			10	13												
B-22	S-4	8.5			17	22												
B-23	S-1	1	-	-	4	5	-	-	-	-	-	-	-	-	-	25.54		
B-23	S-2	3.5	CH	A-7-6(36)	9	12	0	0.5	1.2	1.8	48.4	48.1	59	27	32	29.28		
Minimum moisture content,%=			12.69			Maximum moisture content,%=			31.98	Average moisture content,%=			22.45					
B-24	ST-1	2	CH	A-7-6(28)			0	1.3	4.1	3.4	44.5	46.7	50	21	29	24.56		
B-25	S-1	2	CL	A-6(13)	11	15	2.5	3.9	10.9	6.5	42.9	33.3	39	20	19	20.2		
B-26	ST-1	2	CL	A-6(8)			0	4	7	15.3	10.9	45.3	17.5	39	24	15	18.86	
B-26	S-1	4	-	-	28	38	-	-	-	-	-	-	-	-	-	22.49		
B-27	S-1	1.5	SM	A-6(2)	7	9	5	2.1	33.5	17.8	30.5	11.1	39	26	13	18.37		
Minimum moisture content ("S-" samples only),%=							18.37	Maximum moisture content ("S-" samples only),%=						22.49				
Average moisture content ("S-" samples only),%=							20.35											

Summary of Laboratory Test Results
Unconfined Compressive Strength of Intact Rock Core Specimen

Boring Number	Run Number	Depth (feet)	Description	Unit Weight, pcf	Unconfined Compressive Strength, psi
B-30	1	13.50 - 13.85	Brown to light gray dolomite	144.1	1,720
B-30	3	22.90 - 23.40	Gray dolomite	161.9	12,743
B-30	4	36.15 - 36.55	Gray dolomite	165.1	12,716
B-32	2	21.40 - 21.80	Brown to gray dolomite	149.3	2,579
B-32	3	30.02 - 30.45	Gray dolomite	166.5	15,748
B-39	1	12.65 - 13.00	Brown dolomite	148.5	3,518
B-39	3	20.00 - 20.40	Light to dark gray dolomite	159.2	7,676
B-39	4	31.00 - 31.40	Light to dark gray dolomite	166.1	7,579
B-41	1	17.20 - 17.60	Brown to gray dolomite	154.2	3,341
B-41	3	29.50 - 29.95	Gray to dark gray dolomite	163.8	10,548

minimum = 144.1 1,720
 maximum = 166.5 15,748
 Average = 157.9 7,817

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.6	3.2	1.9	2.0	47.8	43.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	98.4		
#10	95.2		
#40	93.3		
#200	91.3		

Material Description

lean clay

Atterberg Limits

PL= 19 LL= 48 PI= 29

Coefficients

D₉₀= 0.0552 D₈₅= 0.0306 D₆₀= 0.0080
 D₅₀= 0.0042 D₃₀= D₁₅=
 D₁₀= C_u= C_c=

Classification

USCS= CL AASHTO= A-7-6(28)

Remarks

Moisture Content = 26.8%
 Specific Gravity = 2.76

* (no specification provided)

Source of Sample: B-19 Depth: 1.0'-3.0'
 Sample Number: Bag

Date: 10-8-14



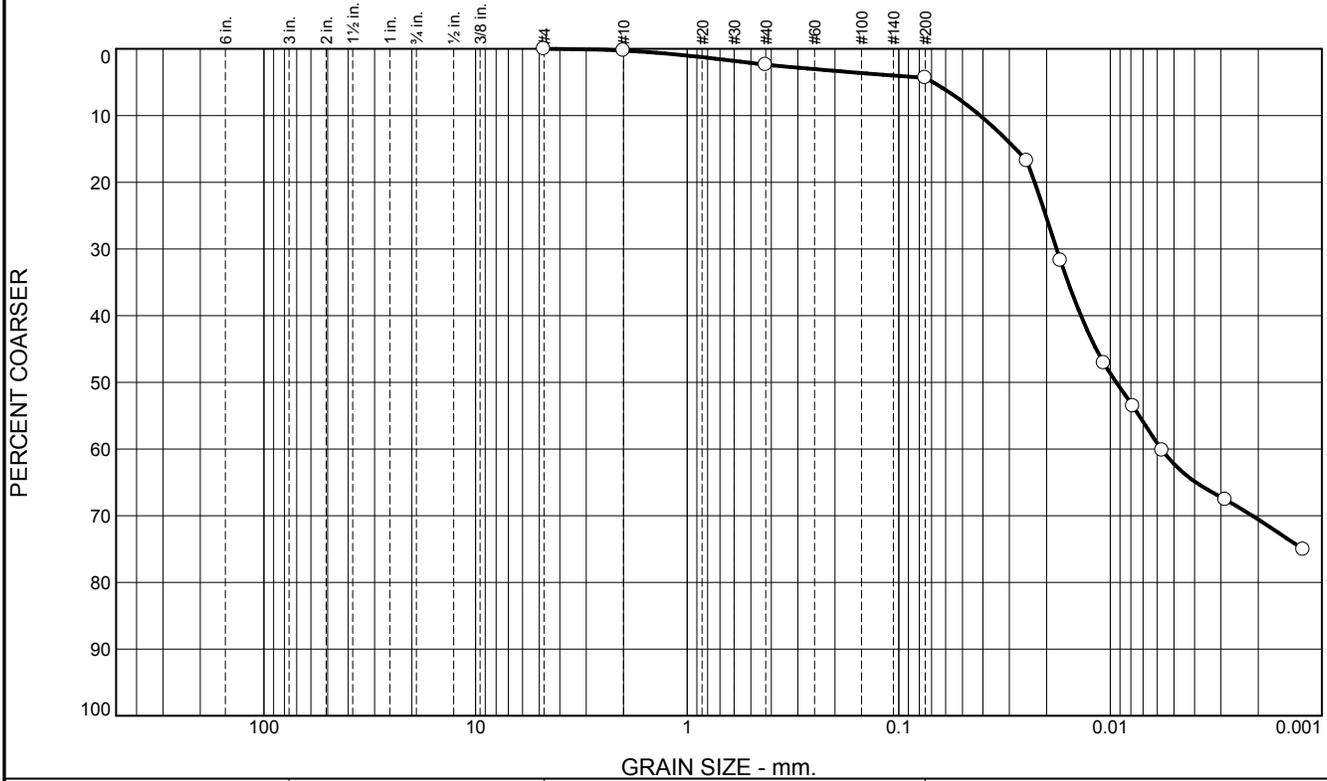
Client: Kentucky Transp. Cabinet
 Project: Oldham County Underpass

Project No: 0631-0006.02

Figure

Tested By: Sean Nicodemus Checked By: Steve Robinson

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.3	2.1	2.0	66.2	29.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.7		
#40	97.6		
#200	95.6		

Material Description

lean clay

Atterberg Limits
 PL= 20 LL= 37 PI= 17

Coefficients
 D₉₀= 0.0412 D₈₅= 0.0280 D₆₀= 0.0138
 D₅₀= 0.0094 D₃₀= 0.0021 D₁₅=
 D₁₀= C_u= C_c=

Classification
 USCS= CL AASHTO= A-6(17)

Remarks
 Moisture Content = 22.4%
 Specific Gravity = 2.74

* (no specification provided)

Source of Sample: B-2
 Sample Number: S-1

Depth: 1.0'-2.5'

Date: 10-6-14



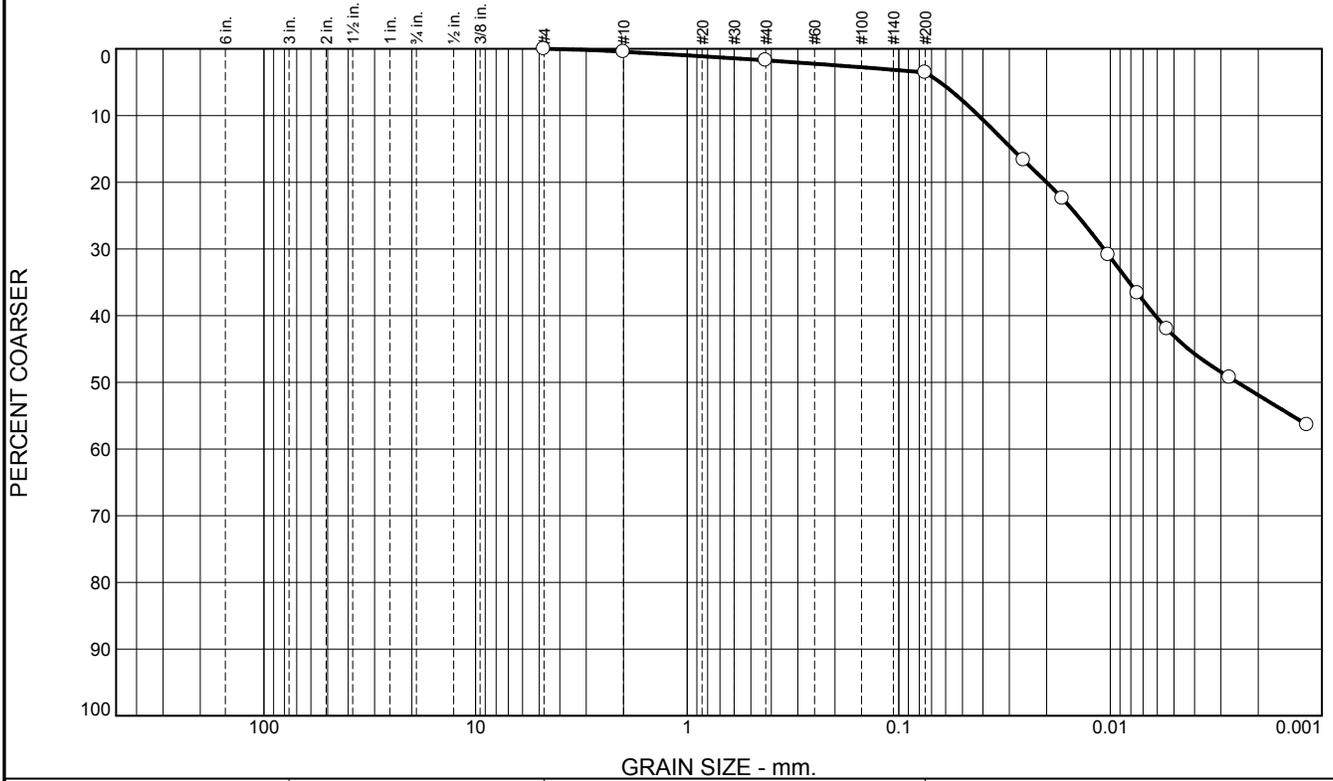
Client: Kentucky Transp. Cabinet
 Project: Oldham County Underpass

Project No: 0631-0006.02

Figure

Tested By: Sheena Marston Checked By: Steve Robinson

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.5	1.2	1.8	48.4	48.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.5		
#40	98.3		
#200	96.5		

Material Description

fat clay

Atterberg Limits

PL= 27 LL= 59 PI= 32

Coefficients

D₉₀= 0.0420 D₈₅= 0.0291 D₆₀= 0.0061
D₅₀= 0.0025 D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= CH AASHTO= A-7-6(36)

Remarks

Moisture Content = 29.3%
Specific Gravity = 2.64

* (no specification provided)

Source of Sample: B-23 Depth: 3.5'-5.0'
Sample Number: S-2

Date: 10-6-14



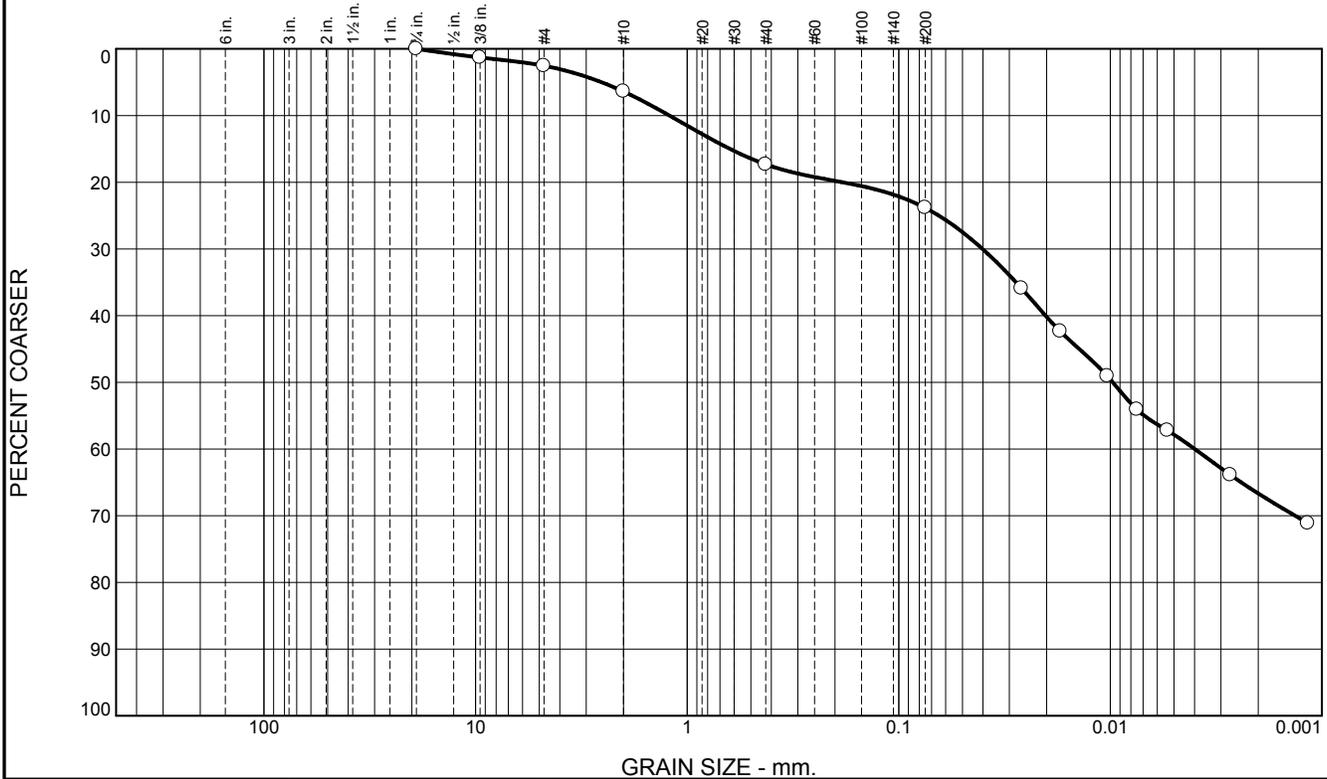
Client: Kentucky Transp. Cabinet
Project: Oldham County Underpass

Project No: 0631-0006.02

Figure

Tested By: Sheena Marston Checked By: Steve Robinson

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.5	3.9	10.9	6.5	42.9	33.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	98.7		
#4	97.5		
#10	93.6		
#40	82.7		
#200	76.2		

Material Description

lean clay with sand

Atterberg Limits

PL= 20 LL= 39 PI= 19

Coefficients

D₉₀= 1.2135 D₈₅= 0.6279 D₆₀= 0.0202
D₅₀= 0.0097 D₃₀= 0.0013 D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(13)

Remarks

Moisture Content = 20.2%
Specific Gravity = 2.84

* (no specification provided)

Source of Sample: B-25 Depth: 2.0'-3.5'
Sample Number: S-1

Date: 10-6-14



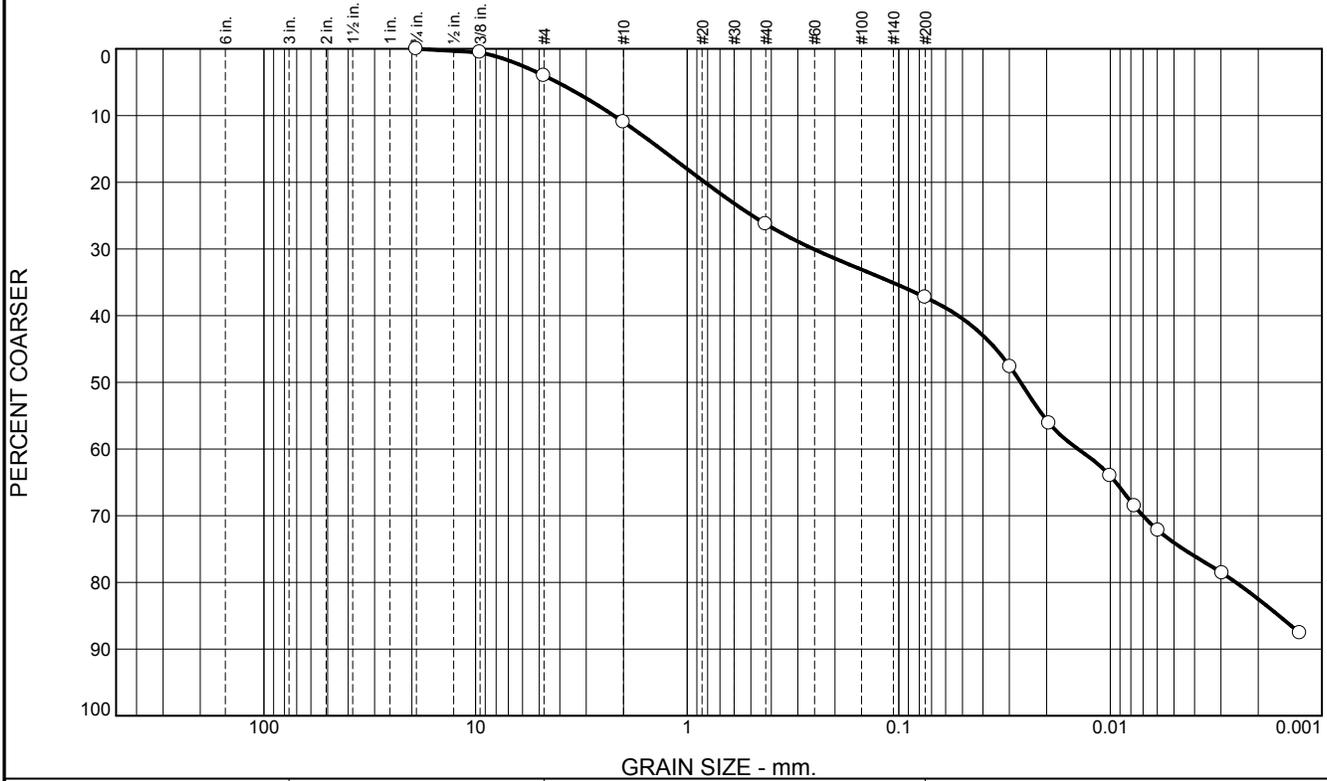
Client: Kentucky Transp. Cabinet
Project: Oldham County Underpass

Project No: 0631-0006.02

Figure

Tested By: Sheena Marston Checked By: Steve Robinson

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.0	7.0	15.3	10.9	45.3	17.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
0.375	99.5		
#4	96.0		
#10	89.0		
#40	73.7		
#200	62.8		

Material Description

sandy lean clay

Atterberg Limits
 PL= 24 LL= 39 PI= 15

Coefficients
 D₉₀= 2.2210 D₈₅= 1.3344 D₆₀= 0.0524
 D₅₀= 0.0265 D₃₀= 0.0070 D₁₅= 0.0016
 D₁₀= C_u= C_c=

Classification
 USCS= CL AASHTO= A-6(8)

Remarks
 Moisture Content = 22.2%
 Specific Gravity = 2.78

* (no specification provided)

Source of Sample: B-26 Depth: 2.0'-4.0'
 Sample Number: S-1

Date: 10-8-14



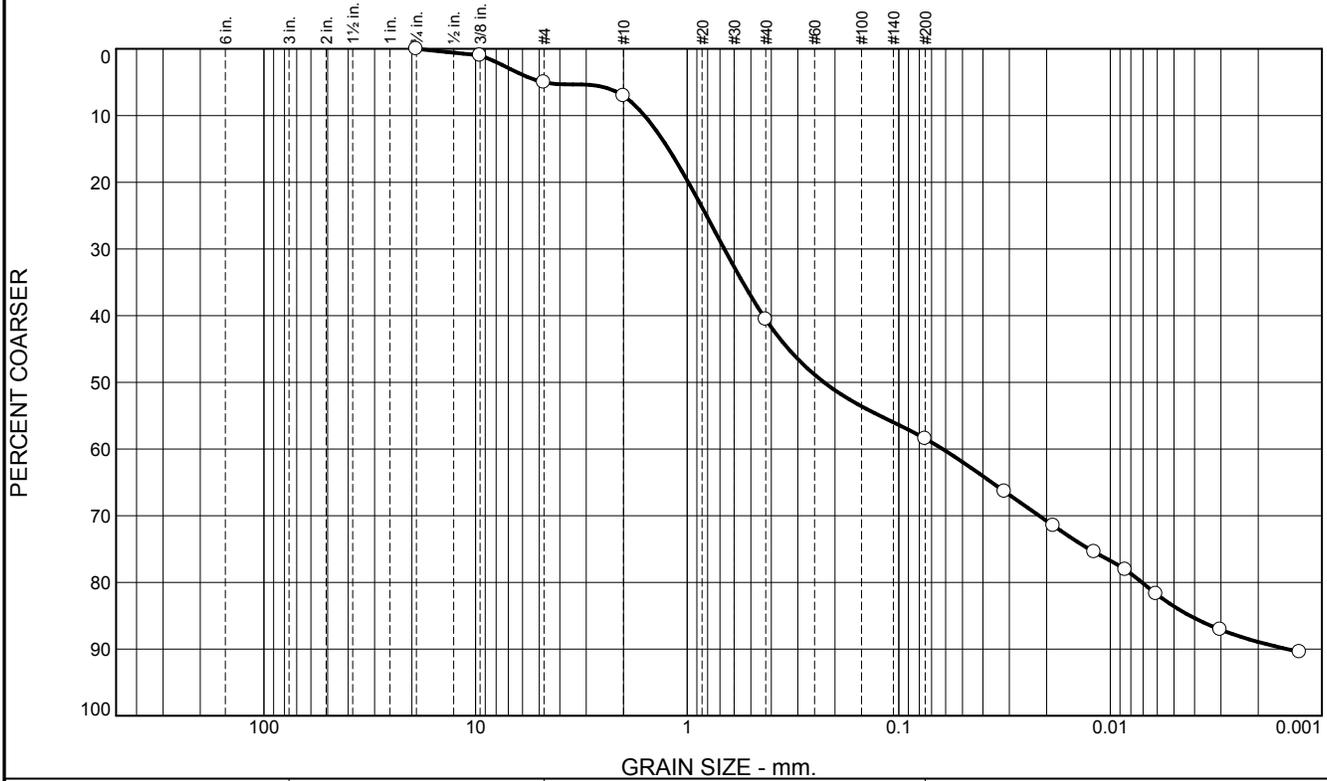
Client: Kentucky Transp. Cabinet
 Project: Oldham County Underpass

Project No: 0631-0006.02

Figure

Tested By: Sean Nicodemus Checked By: Steve Robinson

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.0	2.1	33.5	17.8	30.5	11.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	99.0		
#4	95.0		
#10	92.9		
#40	59.4		
#200	41.6		

Material Description

silty sand

Atterberg Limits
 PL= 26 LL= 39 PI= 13

Coefficients
 D₉₀= 1.5908 D₈₅= 1.2248 D₆₀= 0.4372
 D₅₀= 0.2256 D₃₀= 0.0217 D₁₅= 0.0042
 D₁₀= 0.0015 C_u= 298.98 C_c= 0.74

Classification
 USCS= SM AASHTO= A-6(2)

Remarks
 Moisture Content = 18.4%
 Specific Gravity = 2.81

* (no specification provided)

Source of Sample: B-27 Depth: 1.5'-3.0'
 Sample Number: S-1

Date: 10-7-14



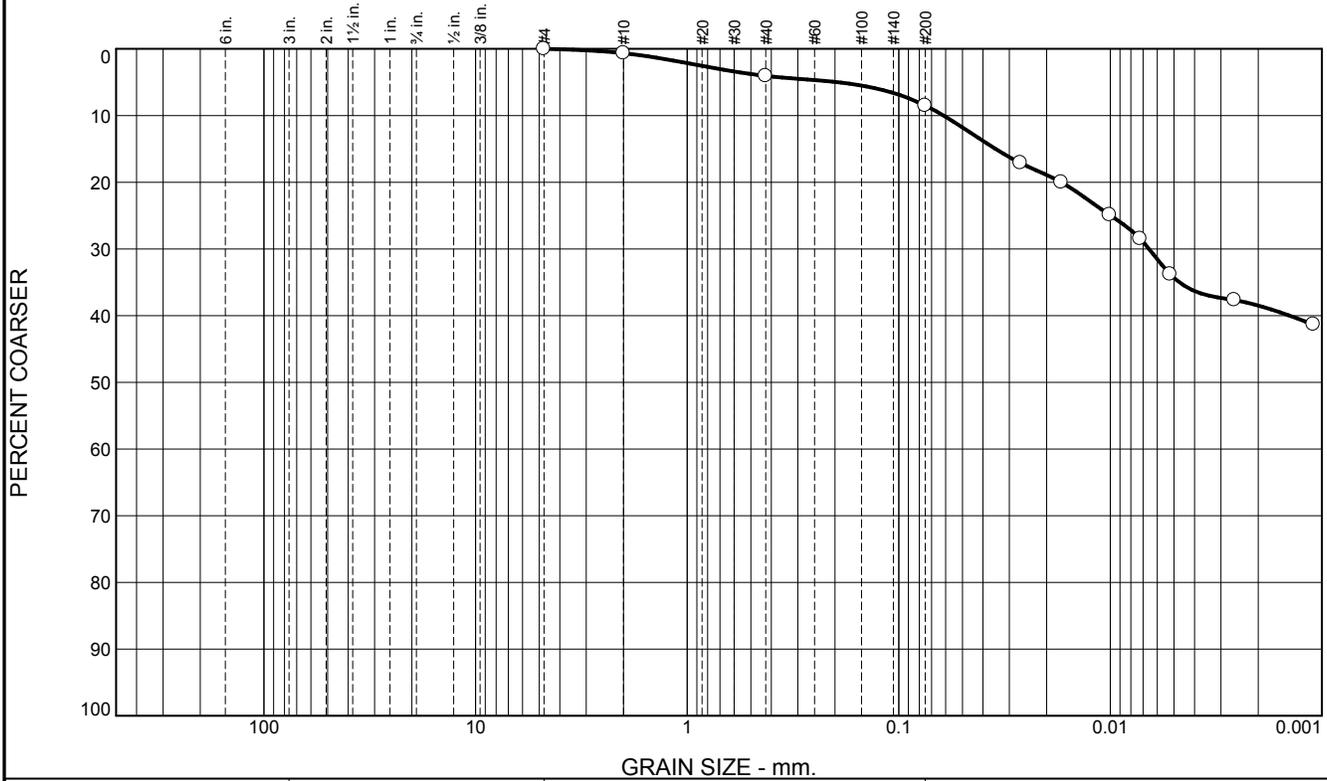
Client: Kentucky Transp. Cabinet
 Project: Oldham County Underpass

Project No: 0631-0006.02

Figure

Tested By: Sheena Marston Checked By: Steve Robinson

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.6	3.5	4.4	30.0	61.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	99.4		
#40	95.9		
#200	91.5		

Material Description

fat clay

Atterberg Limits
 PL= 23 LL= 68 PI= 45

Coefficients
 D₉₀= 0.0615 D₈₅= 0.0349 D₆₀= 0.0014
 D₅₀= D₃₀= D₁₅=
 D₁₀= C_u= C_c=

Classification
 USCS= CH AASHTO= A-7-6(46)

Remarks
 Moisture Content = 38.9%
 Specific Gravity = 2.78

* (no specification provided)

Source of Sample: B-39 Depth: 3.5'-5.0'
 Sample Number: S-2

Date: 10-7-14



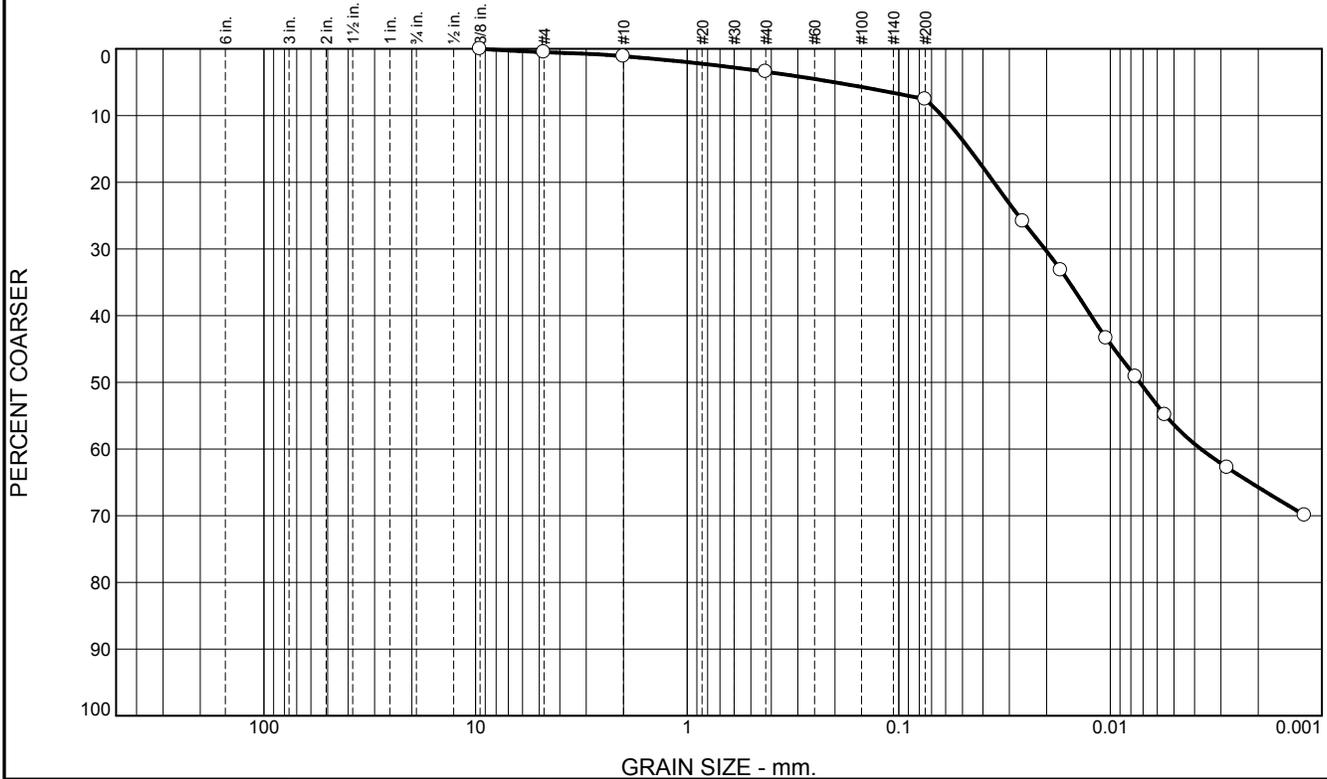
Client: Kentucky Transp. Cabinet
 Project: Oldham County Underpass

Project No: 0631-0006.02

Figure

Tested By: Sheena Marston Checked By: Steve Robinson

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.5	0.6	2.3	4.2	58.1	34.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.5		
#10	98.9		
#40	96.6		
#200	92.4		

Material Description

lean clay

Atterberg Limits

PL= 20 LL= 38 PI= 18

Coefficients

D₉₀= 0.0626 D₈₅= 0.0464 D₆₀= 0.0123
D₅₀= 0.0073 D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(17)

Remarks

Moisture Content = 25.0%
Specific Gravity = 2.72

* (no specification provided)

Source of Sample: B-3b Depth: 1.0'-2.5'
Sample Number: S-1

Date: 10-7-14



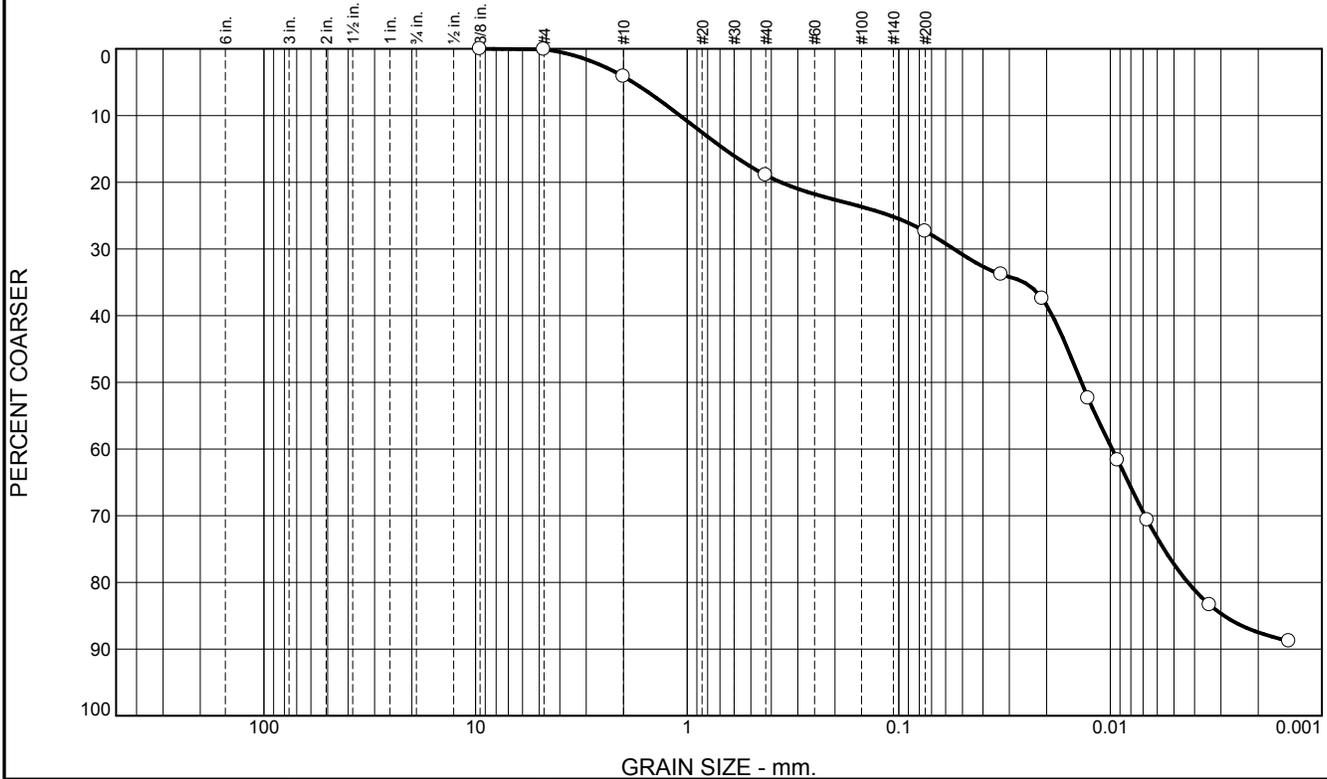
Client: Kentucky Transp. Cabinet
Project: Oldham County Underpass

Project No: 0631-0006.02

Figure

Tested By: Sheena Marston Checked By: Steve Robinson

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	4.0	14.8	8.4	60.2	12.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.9		
#10	95.9		
#40	81.1		
#200	72.7		

Material Description

silt with sand

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D₉₀= 1.0809 D₈₅= 0.6687 D₆₀= 0.0188
D₅₀= 0.0137 D₃₀= 0.0069 D₁₅= 0.0029
D₁₀= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

Moisture Content = 13.4%
Specific Gravity = 2.43

* (no specification provided)

Source of Sample: B-41 Depth: 1.0'-2.5'
Sample Number: S-1

Date: 10-7-14



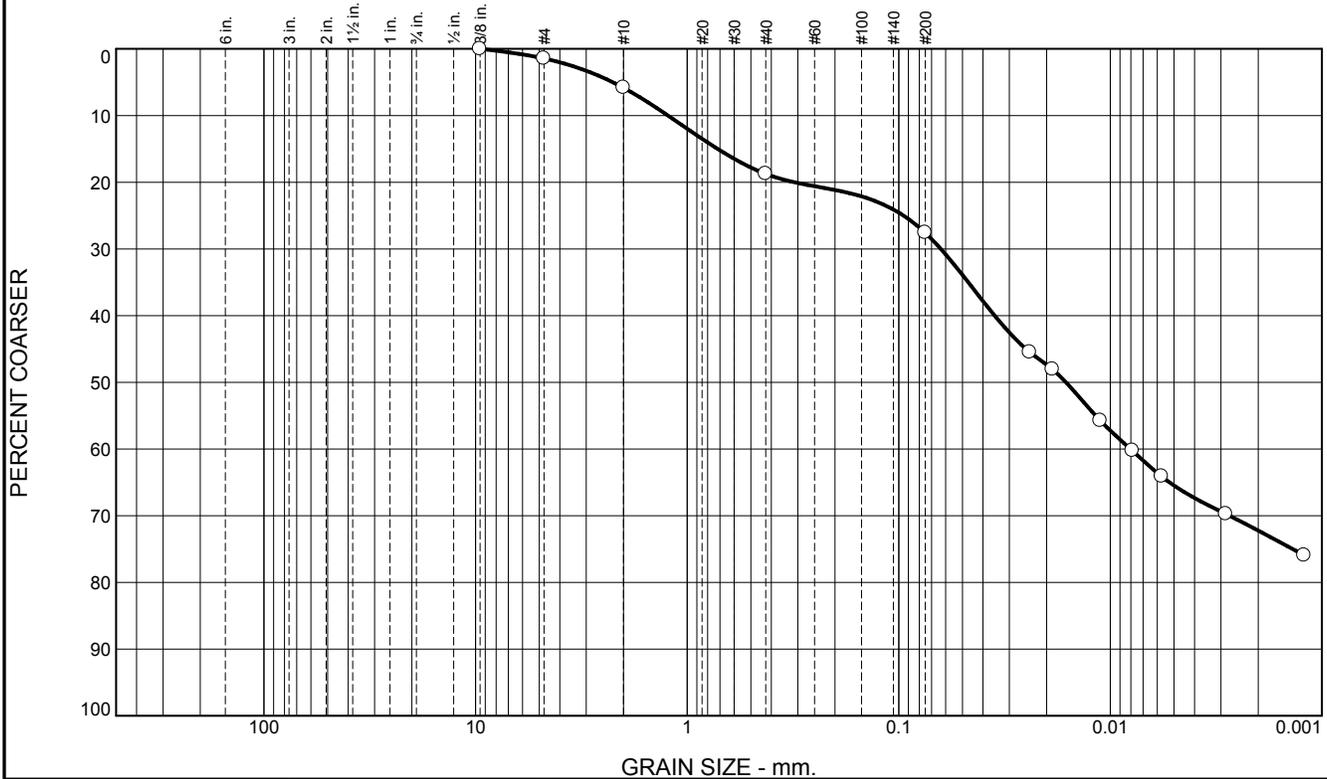
Client: Kentucky Transp. Cabinet
Project: Oldham County Underpass

Project No: 0631-0006.02

Figure

Tested By: Sheena Marston Checked By: Steve Robinson

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	4.4	12.9	8.9	44.6	27.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	98.6		
#10	94.2		
#40	81.3		
#200	72.4		

Material Description

lean clay with sand

Atterberg Limits

PL= 18 LL= 35 PI= 17

Coefficients

D₉₀= 1.2326 D₈₅= 0.7178 D₆₀= 0.0352
D₅₀= 0.0162 D₃₀= 0.0027 D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= CL AASHTO= A-6(10)

Remarks

Moisture Content = 18.3%
Specific Gravity = 2.84

* (no specification provided)

Source of Sample: B-9
Sample Number: Bag

Depth: 3.0'-5.0'

Date: 10-8-14



Client: Kentucky Transp. Cabinet
Project: Oldham County Underpass

Project No: 0631-0006.02

Figure

Tested By: Sean Nicodemus Checked By: Steve Robinson

Moisture-Density Relation Test Results

Project: Oldham County Underpass

Client: Kentucky Transportation Cabinet

Project No.: 0631-0006.02

Curve Number: C-1

MAXIMUM DRY DENSITY:

121.0 pcf

OPTIMUM MOISTURE:

13.8 %

Sample Description:

Lean Clay with Sand (CL)

Sample Source: B-9 Bag Sample

Date Sampled: 7-Oct-14

Proctor: Standard

Method: B

Remarks:

Moisture Content 18.3 %

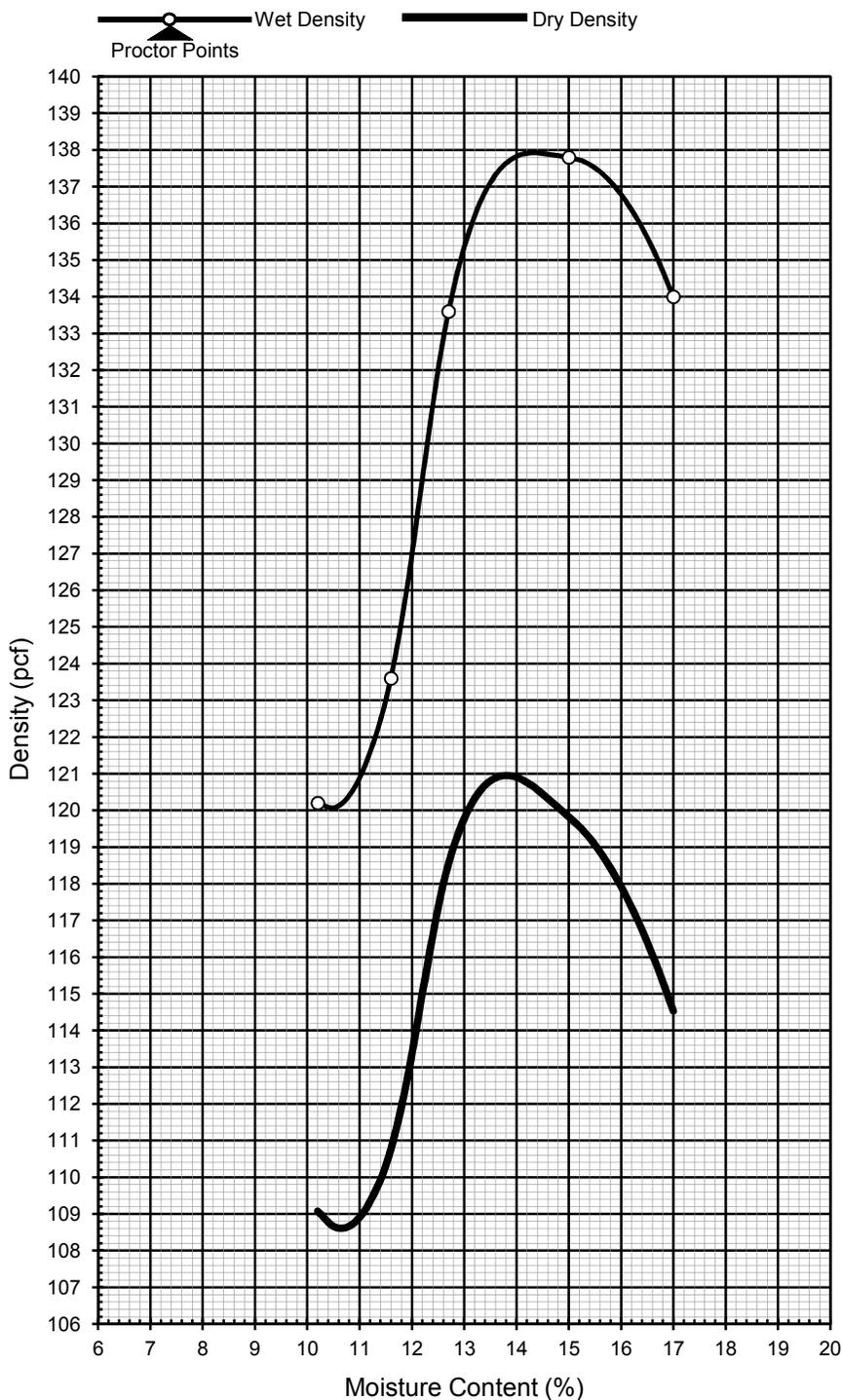
Specific Gravity 2.84

Grain - Size Distribution

Size	Description	%
0.1870"-3.0000"	Aggregate	1.4
0.0787"-0.1870"	Coarse Sand	4.4
0.0165"-0.0787"	Med. Sand	12.9
0.0029"-0.0165"	Fine Sand	8.9
0.0002"-0.0029"	Silt	44.6
Smaller than 0.0002"	Clay	

Plasticity

Liquid Limit	35
Plastic Limit	18
Plasticity Index	17



Moisture-Density Relation Test Results

Project: Oldham County Underpass

Client: Kentucky Transportation Cabinet

Project No.: 0631-0006.02

Curve Number: C-2

MAXIMUM DRY DENSITY:

111.7 pcf

OPTIMUM MOISTURE:

15.7 %

Sample Description:

Lean Clay (CL)

Sample Source: B-13 Bag Sample

Date Sampled: 7-Oct-14

Proctor: Standard

Method: B

Remarks:

Moisture Content 26.2 %

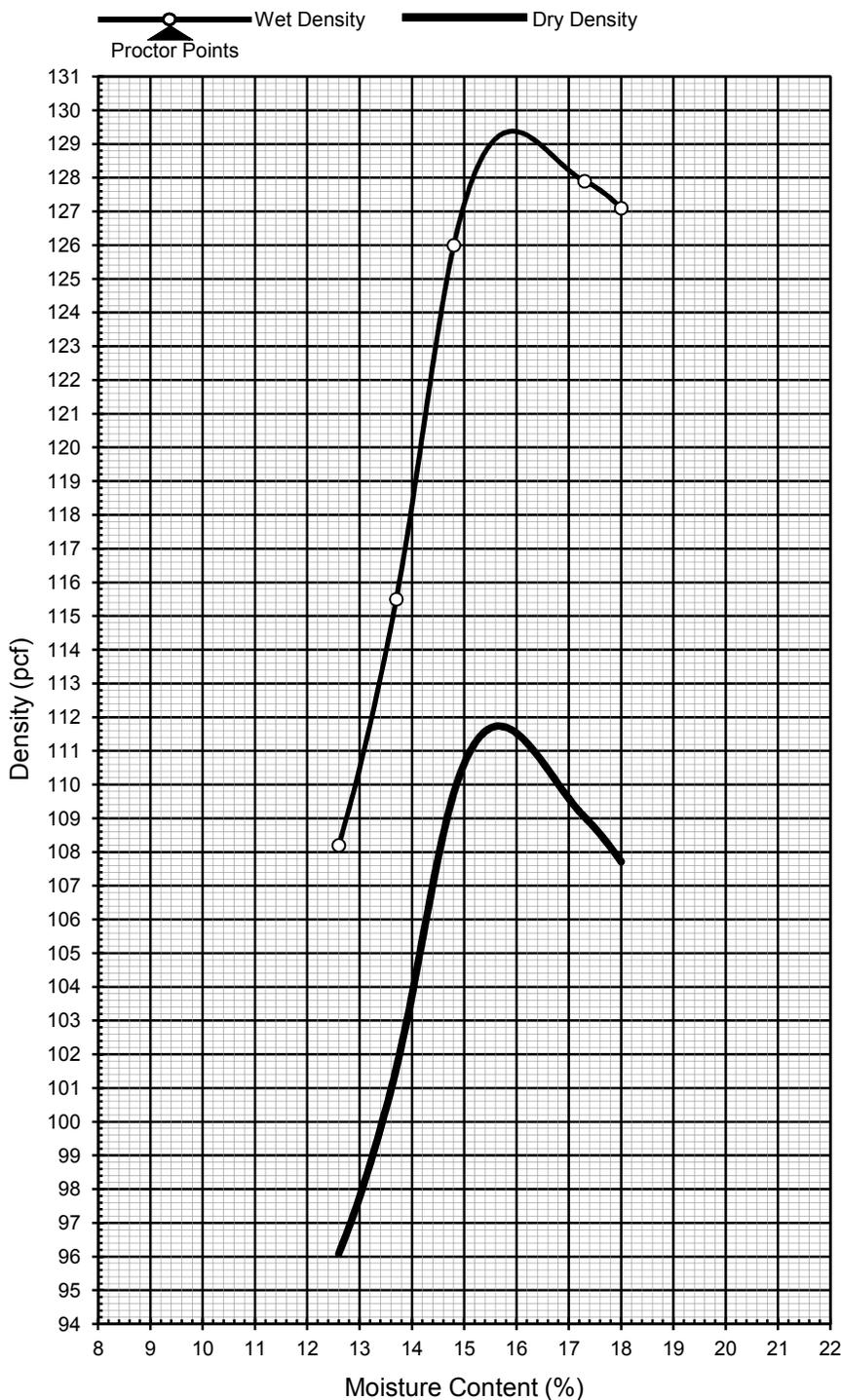
Specific Gravity 2.69

Grain - Size Distribution

Size	Description	%
0.1870"-3.0000"	Aggregate	0
0.0787"-0.1870"	Coarse Sand	2.9
0.0165"-0.0787"	Med. Sand	2.3
0.0029"-0.0165"	Fine Sand	2.6
0.0002"-0.0029"	Silt	57.9
Smaller than 0.0002"	Clay	

Plasticity

Liquid Limit	40
Plastic Limit	20
Plasticity Index	20



Moisture-Density Relation Test Results

Project: Oldham County Underpass

Client: Kentucky Transportation Cabinet

Project No.: 0631-0006.02

Curve Number: C-3

MAXIMUM DRY DENSITY:

111.9 pcf

OPTIMUM MOISTURE:

13.1 %

Sample Description:

Lean Clay (CL)

Sample Source: B-16 Bag Sample

Date Sampled: 7-Oct-14

Proctor: Standard

Method: B

Remarks:

Moisture Content 21.7 %

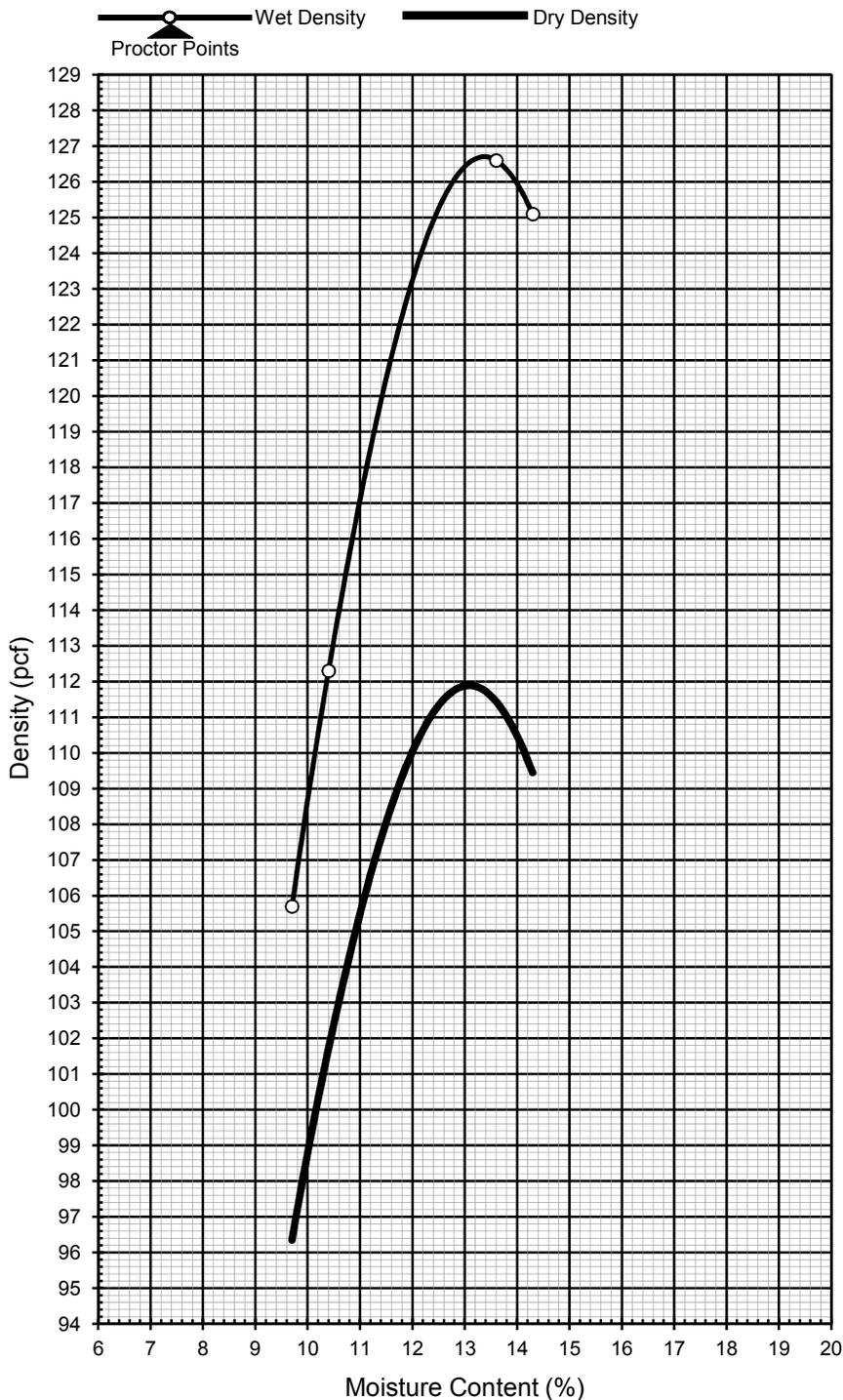
Specific Gravity 2.74

Grain - Size Distribution

Size	Description	%
0.1870"-3.0000"	Aggregate	0.9
0.0787"-0.1870"	Coarse Sand	4
0.0165"-0.0787"	Med. Sand	5.5
0.0029"-0.0165"	Fine Sand	4.9
0.0002"-0.0029"	Silt	54.2
Smaller than 0.0002"	Clay	

Plasticity

Liquid Limit	35
Plastic Limit	17
Plasticity Index	18



Moisture-Density Relation Test Results

Project: Oldham County Underpass

Client: Kentucky Transportation Cabinet

Project No.: 0631-0006.02

Curve Number: C-4

MAXIMUM DRY DENSITY:

113.1 pcf

OPTIMUM MOISTURE:

16.1 %

Sample Description:

Lean Clay (CL)

Sample Source: B-19 Bag Sample

Date Sampled: 7-Oct-14

Proctor: Standard

Method: B

Remarks:

Moisture Content 26.8 %

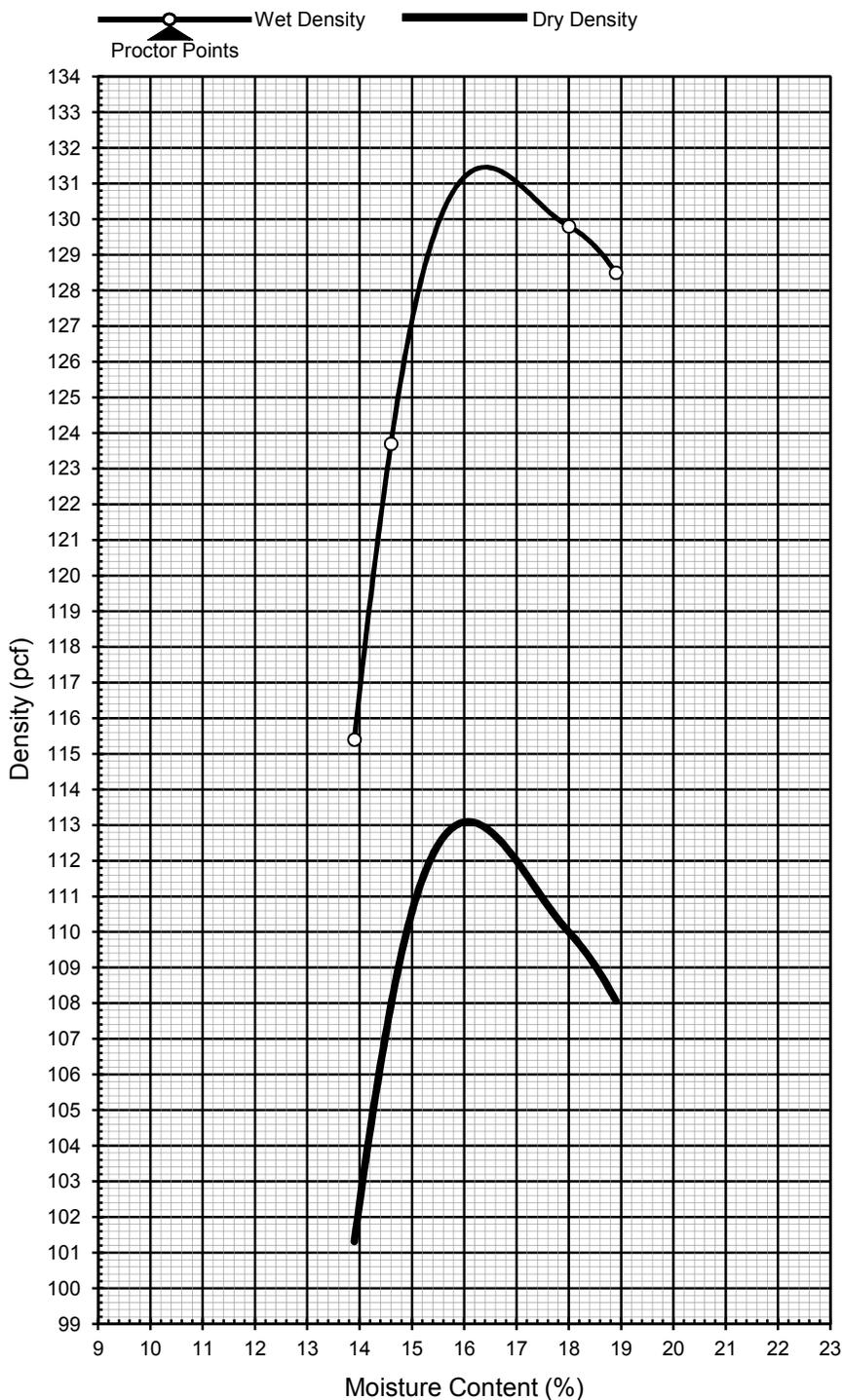
Specific Gravity 2.76

Grain - Size Distribution

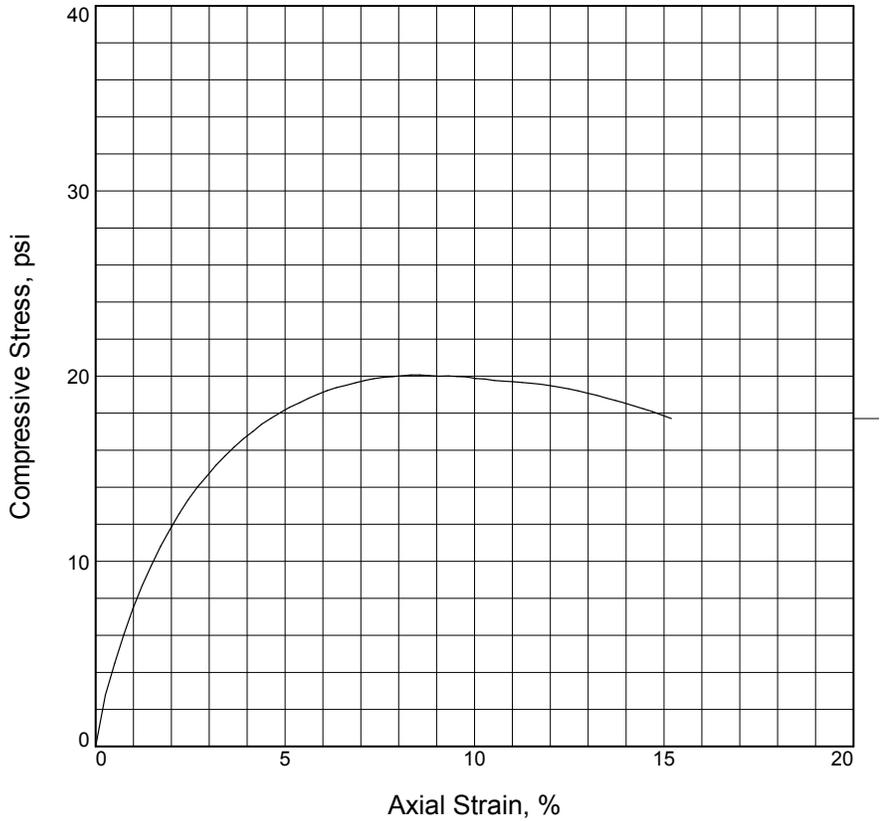
Size	Description	%
0.1870"-3.0000"	Aggregate	1.6
0.0787"-0.1870"	Coarse Sand	3.2
0.0165"-0.0787"	Med. Sand	1.9
0.0029"-0.0165"	Fine Sand	2
0.0002"-0.0029"	Silt	47.8
Smaller than 0.0002"	Clay	

Plasticity

Liquid Limit	48
Plastic Limit	19
Plasticity Index	29



UNCONFINED COMPRESSION TEST



Sample No.	1		
Unconfined strength, psi	20.06		
Undrained shear strength, psi	10.03		
Failure strain, %	8.6		
Strain rate, in./min.	0.06		
Water content, %	24.8		
Wet density, pcf	125.8		
Dry density, pcf	100.8		
Saturation, %	93.7		
Void ratio	0.7473		
Specimen diameter, in.	2.82		
Specimen height, in.	5.60		
Height/diameter ratio	1.99		

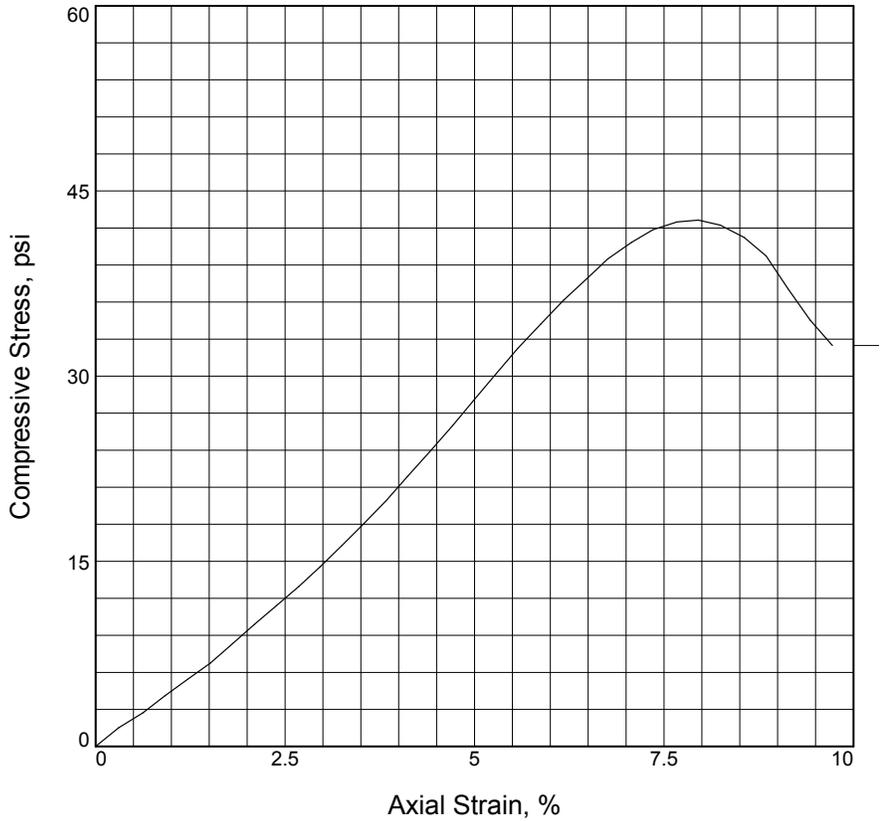
Description: fat clay

LL = 50	PL = 21	PI = 29	GS = 2.82	Type: Presstube
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<p>Project No.: 0631-0006.02</p> <p>Date Sampled: 10-8-14</p> <p>Remarks:</p> <p>Figure _____</p>	<p>Client: Kentucky Transp. Cabinet</p> <p>Project: Oldham County Underpass</p> <p>Source of Sample: B-24 Depth: 2.0'-4.0'</p> <p>Sample Number: S-1</p> <div style="text-align: center;">  </div>
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Tested By: Steve Robinson _____ **Checked By:** Barry Wong _____

UNCONFINED COMPRESSION TEST



Sample No.	1		
Unconfined strength, psi	42.65		
Undrained shear strength, psi	21.32		
Failure strain, %	8.0		
Strain rate, in./min.	0.06		
Water content, %	18.9		
Wet density, pcf	129.5		
Dry density, pcf	109.0		
Saturation, %	88.5		
Void ratio	0.5925		
Specimen diameter, in.	2.86		
Specimen height, in.	4.64		
Height/diameter ratio	1.62		

Description: sandy lean clay

LL = 39	PL = 24	PI = 15	GS = 2.78	Type: Presstube
----------------	----------------	----------------	------------------	------------------------

<p>Project No.: 0631-0006.02</p> <p>Date Sampled: 10-8-14</p> <p>Remarks:</p> <p>Figure _____</p>	<p>Client: Kentucky Transp. Cabinet</p> <p>Project: Oldham County Underpass</p> <p>Source of Sample: B-26 Depth: 2.0'-4.0'</p> <p>Sample Number: S-1</p> <div style="text-align: center;">  </div>
--	--

Tested By: Steve Robinson _____ **Checked By:** Barry Wong _____

Project : **Oldham Co. Underpass**
 Client : **Oldham Co., KY**
 DLZ Job No. : **0631-0006.02**

Sample ID # :	B-9	Plastic Index =	17
USCS Classification :	CL	Optimum Moisture Content (%)	13.8
Maximum Dry Density (PCF) (ASTM D 698)	121.0		

17.5 lb. Surcharge Wt. (SOAKED)

Penetration (in.)	S-1			S-1			S-1		
	Load (lbs.)	Stress (psi)	CBR	Load (lbs.)	Stress (psi)	CBR	Load (lbs.)	Stress (psi)	CBR
0.000	0.00	0.0							
0.025	75.00	25.0							
0.050	133.90	44.6							
0.075	181.72	60.6							
0.100	220.60	73.5	7.4						
0.125	252.49	84.2							
0.150	279.12	93.0							
0.175	301.92	100.6							
0.200	322.05	107.3	7.2						
0.300	390.01	130.0	6.8						
0.400	447.14	149.0	6.5						
0.500	495.62	165.2	6.4						

Reported CBR Value: 6.4

Project : **Oldham Co. Underpass**
 Client : **Oldham Co., KY**
 DLZ Job No. : **0631-0006.02**

Sample ID # :	B-13 & B-16		
USCS Classification :	CL	Plastic Index =	18
Maximum Dry Density (PCF) (ASTM D 698)	111.8	Optimum Moisture Content (%)	14.4

17.5 lb. Surcharge Wt. (SOAKED)

Penetration (in.)	S-1			S-1			S-1		
	Load (lbs.)	Stress (psi)	CBR	Load (lbs.)	Stress (psi)	CBR	Load (lbs.)	Stress (psi)	CBR
0.000	0.00	0.0							
0.025	74.30	24.8							
0.050	139.97	46.7							
0.075	196.57	65.5							
0.100	245.85	81.9	8.2						
0.125	289.28	96.4							
0.150	328.10	109.4							
0.175	363.35	121.1							
0.200	395.83	131.9	8.8						
0.300	509.44	169.8	8.9						
0.400	610.55	203.5	8.8						
0.500	704.55	234.9	9.0						

Reported CBR Value: 8.2

SUBJECT Slake Durability IndexPROCEDURE ASTM D 4644

GAGE ID _____

REMARKS _____

Jar Slake Category = 4

Classification = Non Durable Class 2

SHEET 1 OF 5COMP. BY AA DATE 10/8/14REV. BY SR DATE 10/10/14

Project Name Oldham Co.
 DLZ Project Number 0631-0006.02
 Client Oldham Co. Kentucky Fiscal Court

Sample ID B-30, 18.5'-19.5'
 Date Started 10/7/2014
 Date Completed 10/8/2014

Pan # 570

Wet Wt. & Pan 900.09
 Dry Wt. & Pan 879.21
 Pan Wt. 420.65
 Dry Wt. of Sample (A) 458.56
 % Moisture 4.6

Slake Durability Index to nearest 0.1%

Trial 1Date: 10/7/2014Time: From 9:40 AM
To 9:50 AMInitials AA

Water Temp Start 22
 Water Temp Finish 21.8

Dry Wt. & Pan 815.30
 Pan Wt. 420.65
 Dry Wt. Trial 1 394.65

Trial 2Date: 10/8/2014Time: From 1:05 PM
To 1:15 PMInitials AA

Water Temp Start 22.7
 Water Temp Finish 22.5

Dry Wt. & Pan 713.76
 Pan Wt. 420.65
 Final Dry Wt. (B) 293.11

Slake Durability Index = (B)/(A)*100 63.9Fragment Type: IIITest Pictures

Initial

1st Trial

2nd Trial





SUBJECT Slake Durability Index
 GAGE ID _____

PROCEDURE ASTM D 4644

REMARKS

SHEET 2 OF 5
 COMP. BY AA DATE 10/8/14
 REV. BY SR DATE 10/10/14

Jar Slake Category = 6

Classification = Durable (Reclassified as dolomite; therefore, shale classification is N/A)

Project Name Oldham Co.
 DLZ Project Number 0631-0006.02
 Client Oldham Co. Kentucky Fiscal Court

Sample ID B-30, 30.0'-30.6'
 Date Started 10/7/2014
 Date Completed 10/8/2014

Pan # SH

Wet Wt. & Pan 707.19
 Dry Wt. & Pan 701.55
 Pan Wt. 316.93
 Dry Wt. of Sample (A) 384.62
 % Moisture 1.5

Slake Durability Index to nearest 0.1%

Trial 1

Date: 10/7/2014 Time: From 10:10 AM To 10:20 AM Initials AA

Water Temp Start 22.2
 Water Temp Finish 22.0

Dry Wt. & Pan 699.40
 Pan Wt. 316.93
 Dry Wt. Trial 1 382.47

Trial 2

Date: 10/8/2014 Time: From 11:00 AM To 11:10 AM Initials AA

Water Temp Start 22.0
 Water Temp Finish 21.9

Dry Wt. & Pan 697.38
 Pan Wt. 316.93
 Final Dry Wt. (B) 380.45

Slake Durability Index = (B)/(A)*100 98.9 Fragment Type: I

Test Pictures

Initial

1st Trial

2nd Trial



SUBJECT Slake Durability IndexPROCEDURE ASTM D 4644

GAGE ID _____

REMARKS _____

SHEET 3 OF 5

Jar Slake Category = 3

COMP. BY AA DATE 10/8/14

Classification = Non Durable Class 2

REV. BY SR DATE 10/10/14Project Name Oldham Co.
DLZ Project Number 0631-0006.02
Client Oldham Co. Kentucky Fiscal CourtSample ID B-39, 16.9'-17.5'
Date Started 10/7/2014
Date Completed 10/8/2014Pan # BV-1Wet Wt. & Pan 794.96
Dry Wt. & Pan 783.84
Pan Wt. 325.64
Dry Wt. of Sample (A) 458.20
% Moisture 2.4

Slake Durability Index to nearest 0.1%

Trial 1Date: 10/7/2014Time: From 8:50 AM
To 9:00 AMInitials AAWater Temp Start 21.8
Water Temp Finish 21.4Dry Wt. & Pan 710.70
Pan Wt. 325.64
Dry Wt. Trial 1 385.06Trial 2Date: 10/8/2014Time: From 12:40 PM
To 12:50 PMInitials AAWater Temp Start 22.6
Water Temp Finish 22.2Dry Wt. & Pan 573.08
Pan Wt. 325.64
Final Dry Wt. (B) 247.44Slake Durability Index = (B)/(A)*100 54.0Fragment Type: IITest Pictures

Initial

1st Trial

2nd Trial





SUBJECT Slake Durability Index
 GAGE ID _____

PROCEDURE ASTM D 4644

REMARKS

SHEET 4 OF 5
 COMP. BY AA DATE 10/8/14
 REV. BY SR DATE 10/10/14

Jar Slake Category = 6

Classification = Durable (Reclassified as dolomite; therefore, shale classification is N/A)

Project Name Oldham Co.
 DLZ Project Number 0631-0006.02
 Client Oldham Co. Kentucky Fiscal Court

Sample ID B-39, 26.3'-27.5'
 Date Started 10/7/2014
 Date Completed 10/8/2014

Pan # 576

Wet Wt. & Pan 764.95
 Dry Wt. & Pan 756.34
 Pan Wt. 312.27
 Dry Wt. of Sample (A) 444.07
 % Moisture 1.9

Slake Durability Index to nearest 0.1%

Trial 1

Date: 10/7/2014

Time: From 8:30 AM
 To 8:40 AM

Initials AA

Water Temp Start 21.9
 Water Temp Finish 21.0

Dry Wt. & Pan 748.00
 Pan Wt. 312.27
 Dry Wt. Trial 1 435.73

Trial 2

Date: 10/8/2014

Time: From 11:50 AM
 To 12:00 PM

Initials AA

Water Temp Start 22.9
 Water Temp Finish 22.5

Dry Wt. & Pan 734.75
 Pan Wt. 312.27
 Final Dry Wt. (B) 422.48

Slake Durability Index = (B)/(A)*100 95.1

Fragment Type: I

Test Pictures

Initial

1st Trial

2nd Trial



SUBJECT Slake Durability IndexPROCEDURE ASTM D 4644

GAGE ID _____

REMARKS _____

SHEET 5 OF 5

Jar Slake Category = 4

COMP. BY AA DATE 10/8/14

Classification = Non Durable Class 1

REV. BY SR DATE 10/10/14Project Name Oldham Co.
DLZ Project Number 0631-0006.02
Client Oldham Co. Kentucky Fiscal CourtSample ID B-41, 27.8'-28.4'
Date Started 10/7/2014
Date Completed 10/8/2014Pan # 577Wet Wt. & Pan 796.97
Dry Wt. & Pan 785.97
Pan Wt. 313.67
Dry Wt. of Sample (A) 472.30
% Moisture 2.3

Slake Durability Index to nearest 0.1%

Trial 1Date: 10/7/2014Time: From 9:20 AM
To 9:30 AMInitials AAWater Temp Start 21.8
Water Temp Finish 21.4Dry Wt. & Pan 753.20
Pan Wt. 313.67
Dry Wt. Trial 1 439.53Trial 2Date: 10/8/2014Time: From 11:25 AM
To 11:35 AMInitials AAWater Temp Start 22.7
Water Temp Finish 22.2Dry Wt. & Pan 690.59
Pan Wt. 313.67
Final Dry Wt. (B) 376.92Slake Durability Index = (B)/(A)*100 79.8Fragment Type: IITest Pictures

Initial

1st Trial

2nd Trial





CLIENT KYTC
 PROJECT Oldham Co. Underpass
 SUBJECT _____

DLZ JOB NUMBER 0631-0006.02
 SHEET NO 1 OF 10
 TEST COMP. BY SAR DATE 5/27/15
 CHECKED BY JAN DATE 5/28/15

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012)

Boring No.: B-30 Rock Description: Brown to Light Gray Dolomite
 Run No.: 1
 Depth 13.50'-13.85'

Diameter: 1.972 (D₁) 1.975 (D₂) 1.972 (D₃) 1.975 (D₄) 1.975 (D₅) 1.975 (D₆) 1.974 in (D_{AVG})

Length: 4.038 (L₁) 4.013 (L₂) 4.009 (L₃) 4.020 in (L_{AVG}) $\frac{L}{D} = \underline{2.036}$

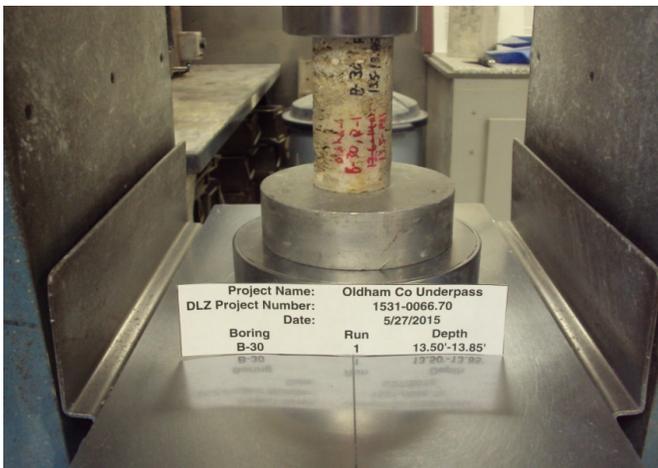
Volume: 0.007116445 ft³ Mass: 464.99 g Unit Weight: 144.05 pcf

Failure 5,265 lbs

Stress: 1,720 psi

Original Specimen

Fractured Specimen





CLIENT KYTC
 PROJECT Oldham Co. Underpass
 SUBJECT _____

DLZ JOB NUMBER 0631-0006.02
 SHEET NO 2 OF 10
 TEST COMP. BY SAR DATE 5/27/15
 CHECKED BY JAN DATE 5/28/15

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012)

Boring No.: 30 Rock Description: Gray Dolomite
 Run No.: 3
 Depth 22.90'-23.40'

Diameter: 1.971 1.979 1.979 1.972 1.979 1.980 1.977 in
 (D₁) (D₂) (D₃) (D₄) (D₅) (D₆) (D_{AVG})

Length: 4.750 4.759 4.752 4.754 in $\frac{L}{D} = \frac{\quad}{\quad} = 2.405$
 (L₁) (L₂) (L₃) (L_{AVG})

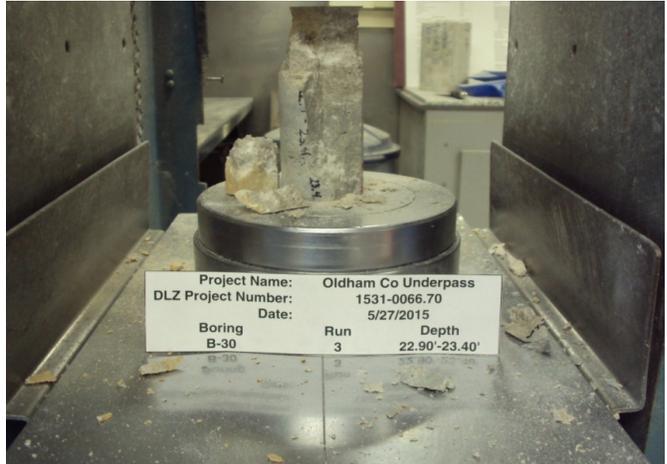
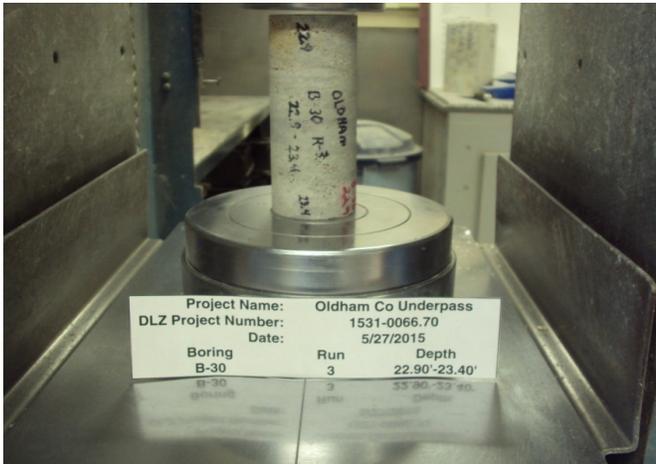
Volume: 0.008437977 ft³ Mass: 619.50 g Unit Weight: 161.86 pcf

Failure 39,105 lbs

Stress: 12,743 psi

Original Specimen

Fractured Specimen





CLIENT KYTC
 PROJECT Oldham Co. Underpass
 SUBJECT _____

DLZ JOB NUMBER 0631-0006.02
 SHEET NO 3 OF 10
 TEST COMP. BY SAR DATE 5/27/15
 CHECKED BY JAN DATE 5/28/15

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012)

Boring No.: B-30 Rock Description: Gray Dolomite
 Run No.: 4
 Depth 36.15'-36.55'

Diameter: 1.971 1.974 1.972 1.972 1.978 1.973 **1.973** in
 (D₁) (D₂) (D₃) (D₄) (D₅) (D₆) (D_{AVG})

Length: 4.581 4.575 4.570 **4.575** in $\frac{L}{D} = 2.319$
 (L₁) (L₂) (L₃) (L_{AVG})

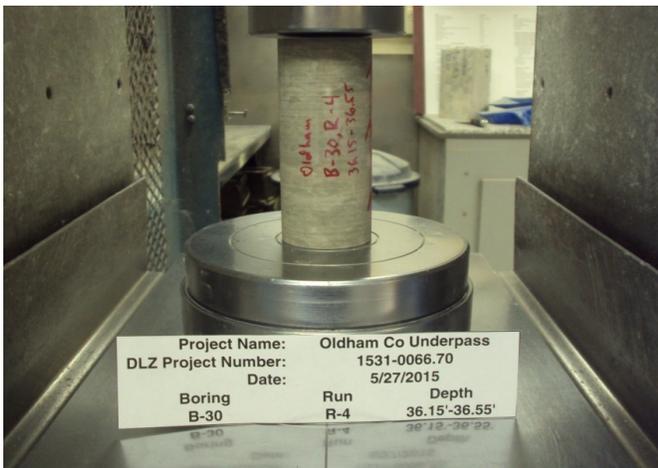
Volume: 0.008094059 ft³ Mass: 606.30 g Unit Weight: **165.14** pcf

Failure 38,890 lbs

Stress: 12,716 psi

Original Specimen

Fractured Specimen





CLIENT KYTC
 PROJECT Oldham Co. Underpass
 SUBJECT _____

DLZ JOB NUMBER 0631-0006.02
 SHEET NO 4 OF 10
 TEST COMP. BY SAR DATE 5/27/15
 CHECKED BY JAN DATE 5/28/15

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012)

Boring No.: B-32 Rock Description: Brown to Gray Dolomite
 Run No.: 2
 Depth 21.40'-21.80'

Diameter: 1.979 1.977 1.973 1.978 1.974 1.972 1.976 in
 (D₁) (D₂) (D₃) (D₄) (D₅) (D₆) (D_{AVG})

Length: 4.719 4.706 4.724 4.716 in $\frac{L}{D} = \underline{\quad 2.387 \quad}$
 (L₁) (L₂) (L₃) (L_{AVG})

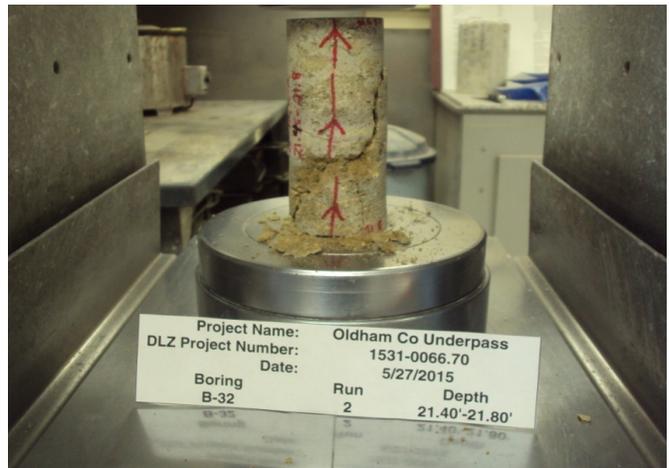
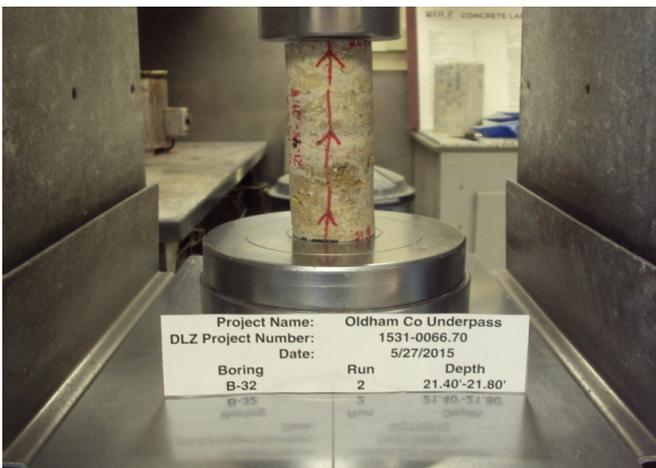
Volume: 0.008361829 ft³ Mass: 566.36 g Unit Weight: 149.32 pcf

Failure 7,905 lbs

Stress: 2,579 psi

Original Specimen

Fractured Specimen





CLIENT KYTC
 PROJECT Oldham Co. Underpass
 SUBJECT _____

DLZ JOB NUMBER 0631-0006.02
 SHEET NO 5 OF 10
 TEST COMP. BY SAR DATE 5/27/15
 CHECKED BY JAN DATE 5/28/15

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012)

Boring No.: B-32 Rock Description: Gray Dolomite
 Run No.: 3
 Depth 30.05'-30.45'

Diameter: 1.977 1.977 1.975 1.978 1.976 1.975 1.976 in
 (D₁) (D₂) (D₃) (D₄) (D₅) (D₆) (D_{AVG})

Length: 4.762 4.752 4.761 4.758 in $\frac{L}{D} =$ 2.408
 (L₁) (L₂) (L₃) (L_{AVG})

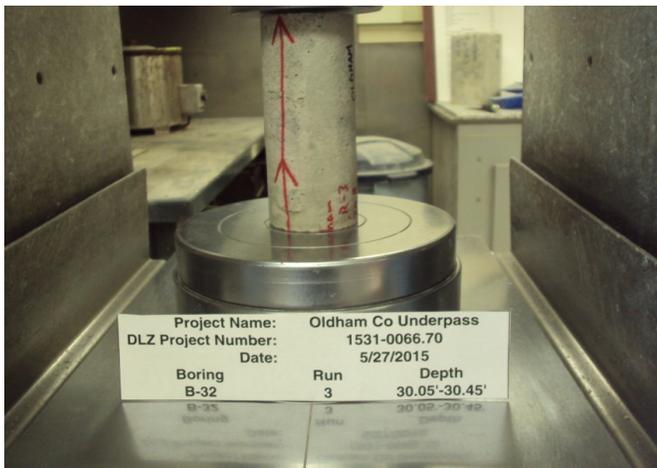
Volume: 0.008443412 ft³ Mass: 637.70 g Unit Weight: 166.51 pcf

Failure 48,310 lbs

Stress: 15,748 psi

Original Specimen

Fractured Specimen





CLIENT KYTC
 PROJECT Oldham Co. Underpass
 SUBJECT _____

DLZ JOB NUMBER 0631-0006.02
 SHEET NO 6 OF 10
 TEST COMP. BY SAR DATE 5/27/15
 CHECKED BY JAN DATE 5/28/15

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012)

Boring No.: B-39 Rock Description: Brown Dolomite
 Run No.: 1
 Depth 12.65'-13.00'

Diameter: 1.973 (D₁) 1.961 (D₂) 1.977 (D₃) 1.978 (D₄) 1.966 (D₅) 1.975 (D₆) **1.972** in (D_{AVG})

Length: 4.150 (L₁) 4.151 (L₂) 4.145 (L₃) **4.149** in (L_{AVG}) $\frac{L}{D} = \underline{\underline{2.104}}$

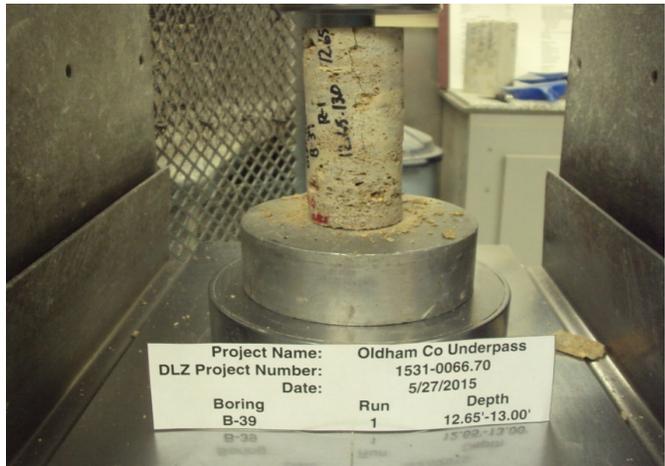
Volume: 0.007326866 ft³ Mass: 493.42 g Unit Weight: **148.47** pcf

Failure 10,740 lbs

Stress: 3,518 psi

Original Specimen

Fractured Specimen





CLIENT KYTC
 PROJECT Oldham Co. Underpass
 SUBJECT _____

DLZ JOB NUMBER 0631-0006.02
 SHEET NO 7 OF 10
 TEST COMP. BY SAR DATE 5/27/15
 CHECKED BY JAN DATE 5/28/15

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012)

Boring No.: B-39 Rock Description: Light to Dark Gray Dolomite
 Run No.: 3
 Depth 20.00'-20.40'

Diameter: 1.981 1.979 1.978 1.980 1.978 1.980 1.979 in
 (D₁) (D₂) (D₃) (D₄) (D₅) (D₆) (D_{AVG})

Length: 4.572 4.575 4.558 4.568 in $\frac{L}{D} = \underline{2.308}$
 (L₁) (L₂) (L₃) (L_{AVG})

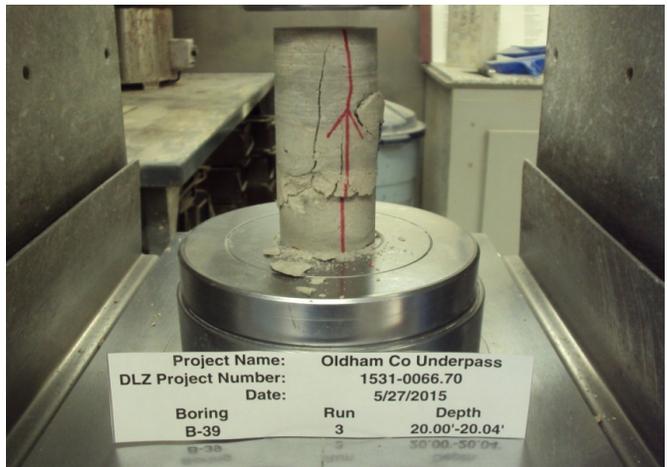
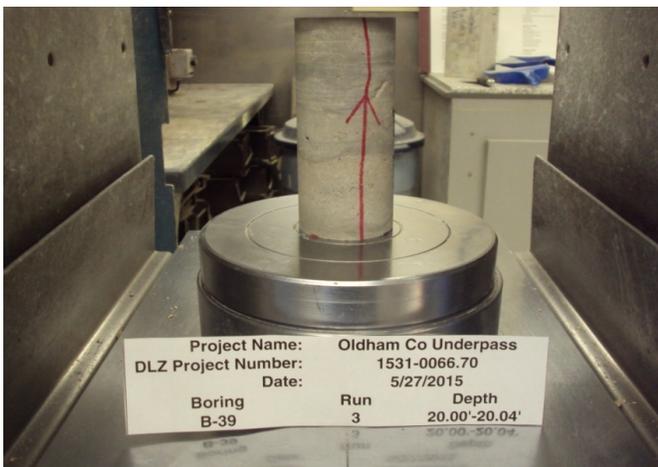
Volume: 0.008130896 ft³ Mass: 587.18 g Unit Weight: 159.21 pcf

Failure 23,620 lbs

Stress: 7,676 psi

Original Specimen

Fractured Specimen





CLIENT KYTC
 PROJECT Oldham Co. Underpass
 SUBJECT _____

DLZ JOB NUMBER 0631-0006.02
 SHEET NO 8 OF 10
 TEST COMP. BY SAR DATE 5/27/15
 CHECKED BY JAN DATE 5/28/15

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012)

Boring No.: B-39 Rock Description: Light to Dark Gray Dolomite
 Run No.: 4
 Depth 31.00'-31.40'

Diameter: 1.971 1.972 1.973 1.975 1.974 1.975 1.973 in
 (D₁) (D₂) (D₃) (D₄) (D₅) (D₆) (D_{AVG})

Length: 4.429 4.427 4.414 4.423 in $\frac{L}{D} = \underline{\quad 2.242 \quad}$
 (L₁) (L₂) (L₃) (L_{AVG})

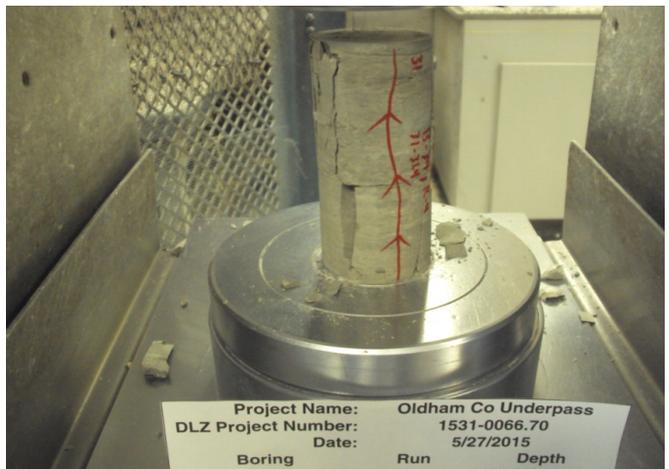
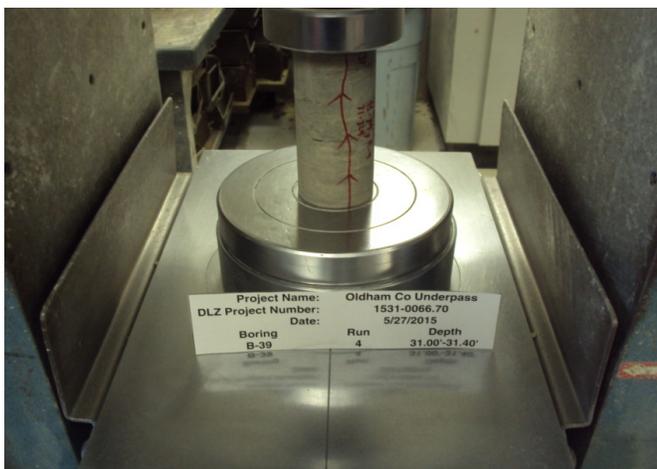
Volume: 0.007825161 ft³ Mass: 589.58 g Unit Weight: 166.11 pcf

Failure 23,180 lbs

Stress: 7,579 psi

Original Specimen

Fractured Specimen





CLIENT KYTC
 PROJECT Oldham Co. Underpass
 SUBJECT _____

DLZ JOB NUMBER 0631-0006.02
 SHEET NO 9 OF 10
 TEST COMP. BY SAR DATE 5/27/15
 CHECKED BY JAN DATE 5/28/15

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012)

Boring No.: B-41 Rock Description: Brown to Gray Dolomite

Run No.: 1

Depth 17.20'-17.60'

Diameter: 1.970 1.970 1.979 1.972 1.975 1.978 1.974 in
 (D₁) (D₂) (D₃) (D₄) (D₅) (D₆) (D_{AVG})

Length: 4.563 4.584 4.570 4.572 in $\frac{L}{D} = \frac{4.572}{1.974} = 2.316$
 (L₁) (L₂) (L₃) (L_{AVG})

Volume: 0.008094218 ft³ Mass: 565.98 g Unit Weight: 154.16 pcf

Failure 10,225 lbs

Stress: 3,341 psi

Original Specimen

Fractured Specimen





CLIENT KYTC
 PROJECT Oldham Co. Underpass
 SUBJECT _____

DLZ JOB NUMBER 0631-0006.02
 SHEET NO 10 OF 10
 TEST COMP. BY SAR DATE 5/27/15
 CHECKED BY JAN DATE 5/28/15

Unconfined Compressive Strength of Intact Rock Core Specimen (ASTM D7012)

Boring No.: B-41 Rock Description: Gray to Dark Gray Dolomite
 Run No.: 3
 Depth 29.50'-29.95'

Diameter: 1.978 1.975 1.977 1.977 1.976 1.977 **1.977** in
 (D₁) (D₂) (D₃) (D₄) (D₅) (D₆) (D_{AVG})

Length: 4.699 4.708 4.701 **4.703** in $\frac{L}{D} = \underline{\underline{2.379}}$
 (L₁) (L₂) (L₃) (L_{AVG})

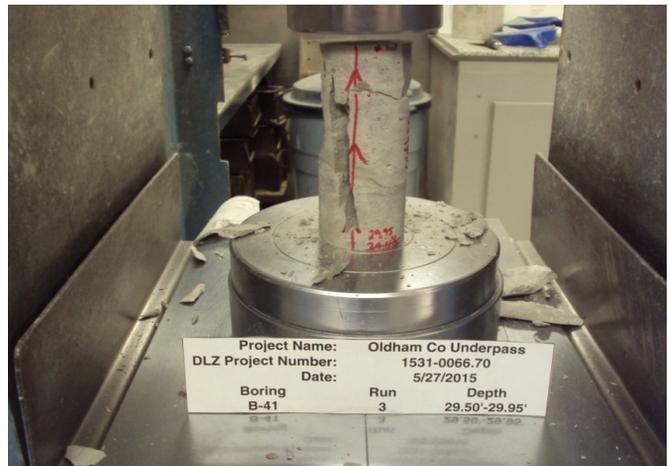
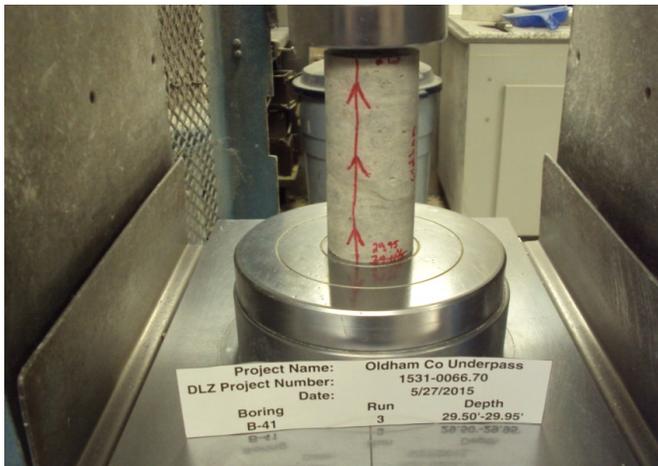
Volume: 0.00834745 ft³ Mass: 620.20 g Unit Weight: **163.80** pcf

Failure 32,370 lbs

Stress: 10,548 psi

Original Specimen

Fractured Specimen



APPENDIX III

Summary of Estimated Amounts of Cuts and Fills
Calculations (Settlement Analyses, Drained Shear Strength Estimate for Fat Clay,
and Stability Analyses)

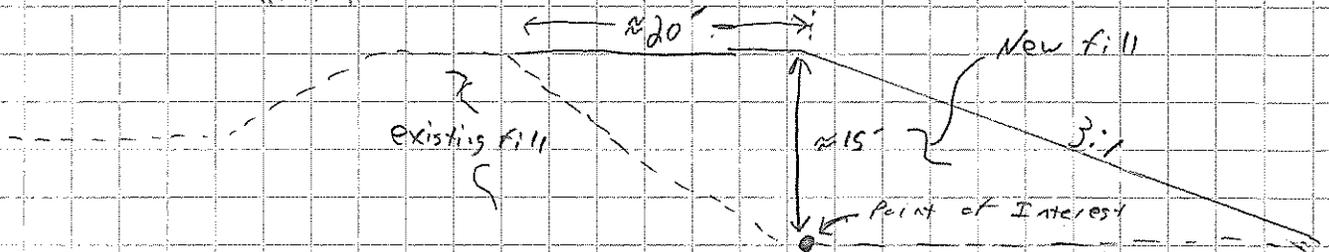
Date: 12-31-14		Summary of Estimated Amounts of Cuts and Fills																		Created By: EWT		Checked By: HH																
5-434.00																																						
Location/Feature	Boring No.	Station	Offset	Surveyed Ex. Grade @ Boring	Prop. Grade @ Boring	Cut (-) @ Boring	Fill (+) @ Boring	Max Cut (-) or Fill (+) at/near Boring Section ¹	Depth to Top of Rock, ft	Top of Rock Elevation	Existing Grade @ Centerline			Top of Proposed Pav't @ Centerline			Cut (-) or Fill (+) to subgrade @ Centerline			Boring No.	Station	Offset	Lowest Subgrade Elevation ²	Subgrade Material at Lowest Subgrade Elev	Lowest Subgrade to Top of Rock (-) below, (+) Above, ft	Highest Subgrade Elevation*	Subgrade Material at Highest Subgrade Elev	Highest Subgrade to Top of Rock (-) below, (+) Above, ft	Depth to Immediate Water Level, ft	Immediate Water Level Elevation, ft	Depth to 24hr Water Level, ft	24hr Water Level Elevation, ft	Depth to Water Level in Observation Well, ft	Elevation to Water Level in Observation Well, ft	Subgrade Submerged?	Boring No.		
											Backward Section from Boring	At Boring	Forward Section from Boring	Backward Section from Boring	At Boring	Forward Section from Boring	Backward Section from Boring	At Boring	Forward Section from Boring																			
Allen Lane	1	141+35	-38.96	770.8	762.0	-8.7	0.0	-12.0	5.5	765.3	766.6	--	768.1	760.2	--	762.1	-7.9	--	-7.5	1.0	141+35	-38.96	758.7	rock	-6.6	760.6	rock	-4.7	--	--	--	--	--	--	--	1.0		
	2	145+28	7.42	789.0	781.0	-8.0	0.0	-11.0	8.5	780.5	788.4	--	789.2	780.3	--	782.2	-9.6	--	-8.5	2.0	145+28	7.42	778.8	rock	-1.7	780.7	CL/rock	0.2	4.5	784.5	4.8	784.2	5.9	783.0	Yes	2.0		
	3a	161+60	-60	790.3	790.2	-0.1	0.0	-4.5/4.6	3.5	786.8	791.9	793.6	795.8	794.8	796.2	797.9	1.4	1.1	0.5	3a	161+60	-60	793.3	fill	6.5	796.4	fill	9.6	787.6	787.6	5.9	784.4	No	3a				
	3b	161+69	17.73	795.4	795.6	0.0	0.1	-4.5/4.6	5.5	789.9	791.9	793.6	795.8	794.8	796.2	797.9	1.4	1.1	0.5	3b	161+69	17.73	793.3	CL	3.4	796.4	fill	6.4	790.3	788.6	3.7	791.8	Yes or No	3b				
	4	138+72	46.85	764.1	755.4	-8.7	0.0	-11.0	8.0	756.1	760.5	--	762.5	755.4	--	755.9	-6.6	--	-8.0	4.0	138+72	46.85	753.9	rock/RDZ	-2.1	754.4	RDZ	-1.6	--	--	--	--	--	--	--	4.0		
	5	141+19	38.89	768.1	760.6	-7.4	0.0	-12.0	7.5	760.6	766.6	--	768.1	760.2	--	762.1	-7.9	--	-7.6	5.0	141+19	38.89	758.7	rock/RDZ	-1.9	760.6	RDZ	0.0	--	--	--	--	--	--	--	5.0		
	6	145+05	-30	787.3	780.9	-6.5	0.0	-12.0	8.5	778.8	786.7	788.4	789.2	778.0	782.2	-10.2	-9.7	-8.5	6.0	145+05	-30	776.5	rock/RDZ	-2.4	780.7	CL	-1.9	--	--	--	--	--	--	--	6.0			
	7	147+13	-37.81	789.4	784.7	-4.7	0.0	-8.0	7.0	782.4	790.6	--	788.9	785.8	--	786.3	-6.3	--	-4.1	7.0	147+13	-37.81	784.3	CL	1.9	784.8	CL	2.3	--	--	--	--	--	--	--	7.0		
	8	138+18	3.32	759.7	755.1	-4.6	0.0	-10.0	8.5	751.2	756.7	--	760.5	754.9	--	755.4	-3.2	--	-6.6	8.0	138+18	3.32	753.4	CL	2.2	753.9	CL	2.7	--	--	--	--	--	--	--	8.0		
	9	140+03	-1.25	763.5	757.6	-6.0	0.0	-11.5	8.5	755.0	759.8	763.3	765.4	756.5	757.4	758.7	-4.8	-7.4	-8.3	9.0	140+03	-1.25	755.0	RDZ	0.0	757.2	CL	2.1	--	--	--	--	--	--	--	RDZ	9.0	
	10	142+00	0	770.9	764.2	-6.6	0.0	-12	0.8	770.1	768.1	770.8	774.0	762.1	764.2	766.7	-7.6	-8.1	-8.8	10.0	142+00	0	760.6	rock	-9.5	765.2	rock	-4.9	--	--	--	--	--	--	--	rock	10.0	
	11	144+00	0	784.1	775.3	-8.8	0.0	-12	3.5	780.6	780.5	784.0	786.7	772.4	775.3	778.0	-9.7	-10.2	-10.2	11.0	144+00	0	770.9	rock	-9.7	776.5	rock	-4.1	--	--	--	--	--	--	--	rock	11.0	
	12	146+00	0	789.5	783.8	-5.7	0.0	-10	7.5	782.0	789.2	789.4	790.2	782.2	783.8	785.0	-8.5	-7.2	-6.8	12.0	146+00	0	780.7	rock/RDZ	-1.3	783.5	CL	1.5	--	--	--	--	--	--	rock/RDZ	12.0		
	13	148+00	0	787.0	786.5	-0.5	0.0	-6	7.5	779.5	788.9	787.3	786.6	786.3	786.5	786.8	-4.1	-2.3	-1.3	13.0	148+00	0	784.8	CL	5.2	785.3	CL	5.7	--	--	--	--	--	--	--	13.0		
	14	150+00	0	791.3	787.5	-3.8	0.0	-7	8.5	782.8	789.0	791.0	791.7	787.3	787.5	787.8	-3.2	-5.0	-5.4	14.0	150+00	0	785.8	CL	3.0	786.3	CL	3.5	--	NFW	NFW	NFW	--	--	--	--	14.0	
	15	153+70	-12.11	790.0	789.0	-1.0	0.0	-9.5	7.0	783.0	791.1	--	791.5	789.3	--	789.6	-3.2	--	-3.4	15.0	153+70	-12.11	787.8	CL	4.8	788.1	CL	5.1	--	NFW	NFW	NFW	--	--	--	--	15.0	
	16	158+01	-4	796.1	791.6	-4.5	0.0	-8.5	4.0	792.1	796.3	796.2	796.0	791.4	791.7	791.9	-6.4	-6.1	-5.6	16.0	158+01	-4	789.9	rock/RDZ	-2.2	790.4	rock/RDZ	-1.6	--	--	--	--	--	--	rock/RDZ	16.0		
	17	162+00	18.91	797.1	797.3	0.0	0.3	-9/+7	2.0	795.1	793.6	795.8	798.6	796.2	797.9	799.8	1.1	0.5	-0.3	17.0	162+00	18.91	794.7	RDZ	-0.4	798.3	fill	3.2	--	--	--	--	--	--	RDZ	17.0		
18	166+04	32.06	821.4	817.4	-3.9	0.0	-6/+4.5	0.5	820.9	816.1	818.1	821.3	814.6	817.1	819.7	-3.0	-2.5	-3.1	18.0	166+04	32.06	813.1	rock	-7.8	818.2	rock/RDZ	-2.7	--	--	--	--	--	--	rock/RDZ	18.0			
Allen Lane Grade Separation	19	168+05	-5.16	828.6	827.0	-1.7	0.0	-16 (roadway), -26 (bridge)	3.5	825.1	825.4	828.3	834.8	824.4	826.7	828.9	-2.5	-3.1	-7.4	19.0	168+05	-5.16	822.9	rock	-2.2	827.4	CL	2.3	--	NFW	NFW	NFW	--	--	--	--	rock	19.0
	20	172+00	-0.6	856.3	844.7	-11.6	0.0	-20 (bridge)	12.0	844.3	856.2	856.2	856.2	842.4	844.7	846.9	-15.3	-13.0	-10.8	20.0	172+00	-0.6	840.9	rock/RDZ	-3.4	845.4	CH	1.1	--	--	--	--	--	--	rock/RDZ	20.0		
	21	174+00	-0.9	854.5	852.3	-2.2	0.0	-8/+2	11.0	843.5	855.1	854.2	853.3	851.0	852.3	853.2	-5.6	-3.4	-1.6	21.0	174+00	-0.9	849.5	CH	6.0	851.7	CH	8.2	10.9	843.6	--	--	--	--	--	--	21.0	
RR Runaround	22	171+00	-262.4	856.2	859.0	--	2.8	@Sta1526+00-10'	13.0	843.2	--	--	--	--	--	--	--	--	22.0	171+00	-262.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22.0		
	23	171+13	298.68	861.6	864.0	--	2.4	@Sta1532+00-3'	5.5	856.1	--	--	--	--	--	--	--	--	23.0	171+13	298.68	--	--	--	--	--	--	--	--	--	--	--	--	--	23.0			
Commerce Parkway	24	44+00	-7	752.0	751.9	-0.1	0.0	-8	8.5	743.5	--	752	752.2	--	752.0	752.2	--	-1.5	-1.5	24.0	44+00	-7	750.5	CH	7.0	750.7	CH	7.2	--	--	--	--	--	--	--	24.0		
	25	48+00	-7	754.1	753.9	-0.2	0.0	-8/+2	8.0	746.1	753.9	754.3	754.5	753.9	754.2	754.5	-1.4	-1.5	-1.5	25.0	48+00	-7	752.4	CL	6.4	753.0	CL	6.9	--	--	--	--	--	--	--	25.0		
	26	52+00	-7	756.2	756.1	0.0	0.0	-7/+2.5	8.5	747.7	755.9	756.1	756.3	756.0	756.2	756.5	-1.4	-1.4	-1.4	26.0	52+00	-7	754.5	CL	6.8	755.0	CL	7.3	--	--	--	--	--	--	--	26.0		
	27	57+00	7	758.5	758.5	0.0	0.0	-3	4.0	754.5	758.5	758.6	--	758.5	758.6	--	-1.5	-1.5	--	27.0	57+00	7	757.0	SM	2.5	757.1	SM	2.6	--	--	--	--	--	--	--	27.0		

¹The final cut depth should include the cut depth to the ditch, wherever applicable

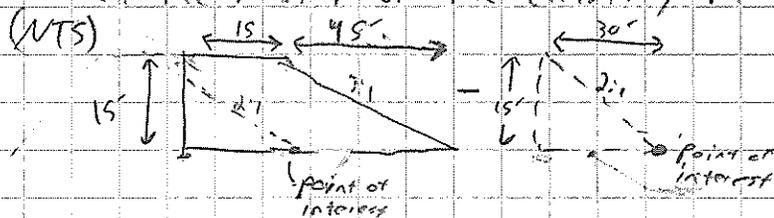
²Assuming 1.5' thick pavement

Bridge Side Slope Fill

- Consider the settlement of the embankment fill from the railroad extension.
- The new fill is anticipated to be approximately 15' high with a 2H:1V side slope, (see sketch below) on the south slope of the existing railroad embankment.

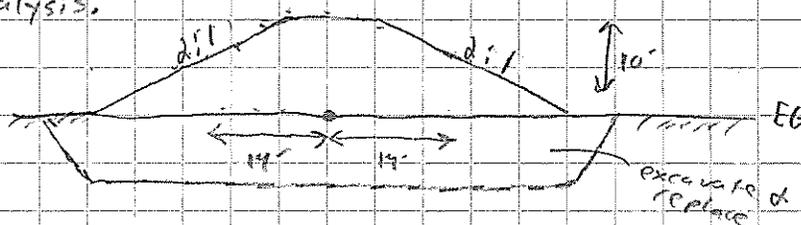


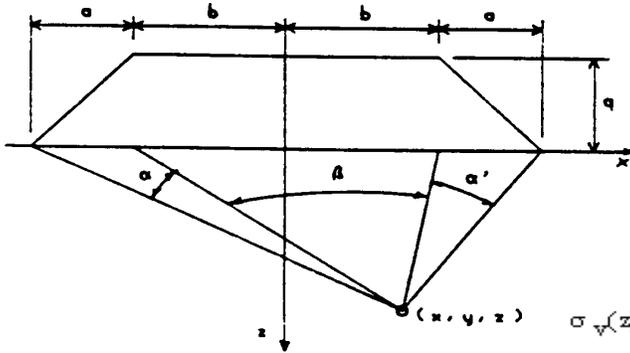
- Assume Boussinesq solution for increase in vertical stress beneath embankment (Ref: ERM1110-1-1904, UMAC)
- See attached settlement analysis spreadsheet for soil layers/properties
- Based on the plans and the subsurface conditions encountered in the borings, a generalized, critical profile has been assumed.
- Consider super positioning of the embankment as a trapezoidal loading, then the relief of the existing fill. See sketch below.



Railroad Embankment fill

- For the railroad runaround embankment, the cross section below has been assumed.
- A 5' foot undercut of the foundation soils is required for the slope stability. This 5' foot is assumed to be relatively incompressible for the settlement analysis.



Without Soil Stabilization
SETTLEMENT ANALYSIS - EMBANKMENT
Embankment Informaiton:

 Groundwater Table: D= 11.0 ft
 Embankment Height: H= 11 ft
 Fill Unit Weight: $\gamma_{emb} = 125$ pcf $q = 1,375$ psf
 Width of Slope: a= 20
 Top half-width of Emb: b= 14
 Distance from CL: x= 0
 Output Range: z= 0 to 11 ft

*See Data output Attached

$$\sigma_v(z) := \left(\frac{q}{\pi a} \right) (a(\alpha(z) + \beta(z) + \alpha'(z)) + b(\alpha(z) + \alpha'(z)) + x(\alpha(z) - \alpha'(z)))$$

$$\beta(z) := \text{atan} \left[\frac{(b-x)}{z} \right] + \text{atan} \left[\frac{(b+x)}{z} \right]$$

$$\alpha'(z) := \text{atan} \left[\frac{(a+b-x)}{z} \right] - \text{atan} \left[\frac{(b-x)}{z} \right]$$

$$\alpha(z) := \text{atan} \left[\frac{(a+b+x)}{z} \right] - \text{atan} \left[\frac{(b+x)}{z} \right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Cohesionless

Soil Properties:

Settlement is calculated at mid-point of layer

No.	Bot. of Laye	Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma_z$ (psf)	σ'_f (psf)	Soils			
								C'	C_r	C_c	e_o
1	5.0 ft	A-7-5/CH	130	1,755	325	1,374	1,699	0.0	0.05	0.54	0.990
2	13.0 ft	A-7-5/CH	130	3,120	1,170	1,341	2,511	0.0	0.05	0.54	0.990
3											
4											
5											
6											
7											
8											
9											
10											

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_o < \sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \sum \frac{C_r}{1+e_o} H \log \left(\frac{\sigma'_f}{\sigma'_o} \right)$$

Overconsolidated Soils - Case II ($\sigma'_o < \sigma'_c < \sigma'_f$) Eqn:11.25

$$(\delta_c)_{ult} = \sum \left[\frac{C_r}{1+e_o} H \log \left(\frac{\sigma'_c}{\sigma'_o} \right) + \frac{C_c}{1+e_o} H \log \left(\frac{\sigma'_f}{\sigma'_c} \right) \right]$$

Normally Consolidated Soils ($\sigma'_o = \sigma'_c$) Eqn: 11.23

$$(\delta_c)_{ult} = \sum \frac{C_c}{1+e_o} H \log \left(\frac{\sigma'_f}{\sigma'_o} \right)$$

Reference: FHWA NHI-00-045

Cohesionless Soils ($\sigma'_o = \sigma'_c$)

$$(\delta_c)_{ult} = \sum \frac{1}{C'} H \log \left(\frac{\sigma'_f}{\sigma'_o} \right)$$

No. Settlement: Total Settlement

1	0.097 ft	0.169 ft
2	0.072 ft	
3		2.0 in
4		
5		
6		
7		
8		
9		
10		



SUBJECT

Client KYTC

JOB NUMBER 0631.006.02

Project Oldham County Underpass

SHEET NO. OF

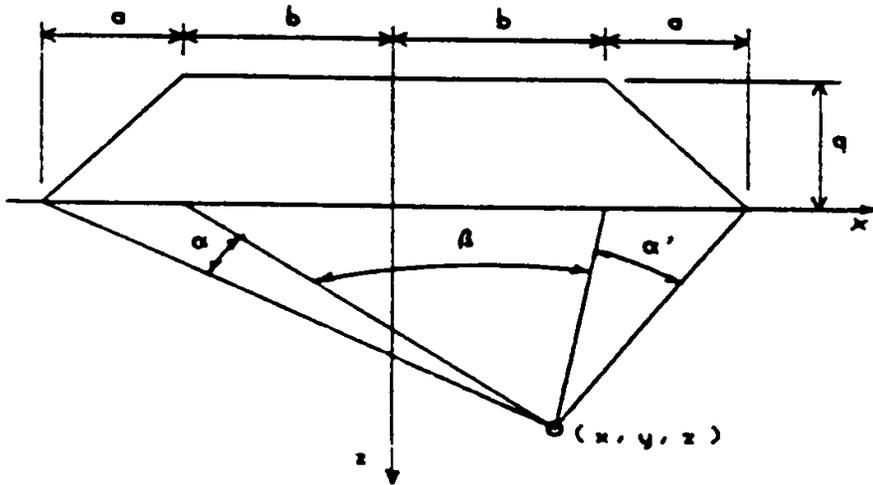
Item Settlement of RR Embankment

COMP. BY MDK DATE 01/09/15

0

CHECKED BY HJH DATE 01/16/15

INCREASE IN VERTICAL STRESS DUE TO EMBANKMENT LOADING



11
 15 1375 load
 0
 45 20 width of slope
 15
 b = 14 top half-width of
 13 embankment
 x = 0 distance from CL
 z = 0 to 11 depth range

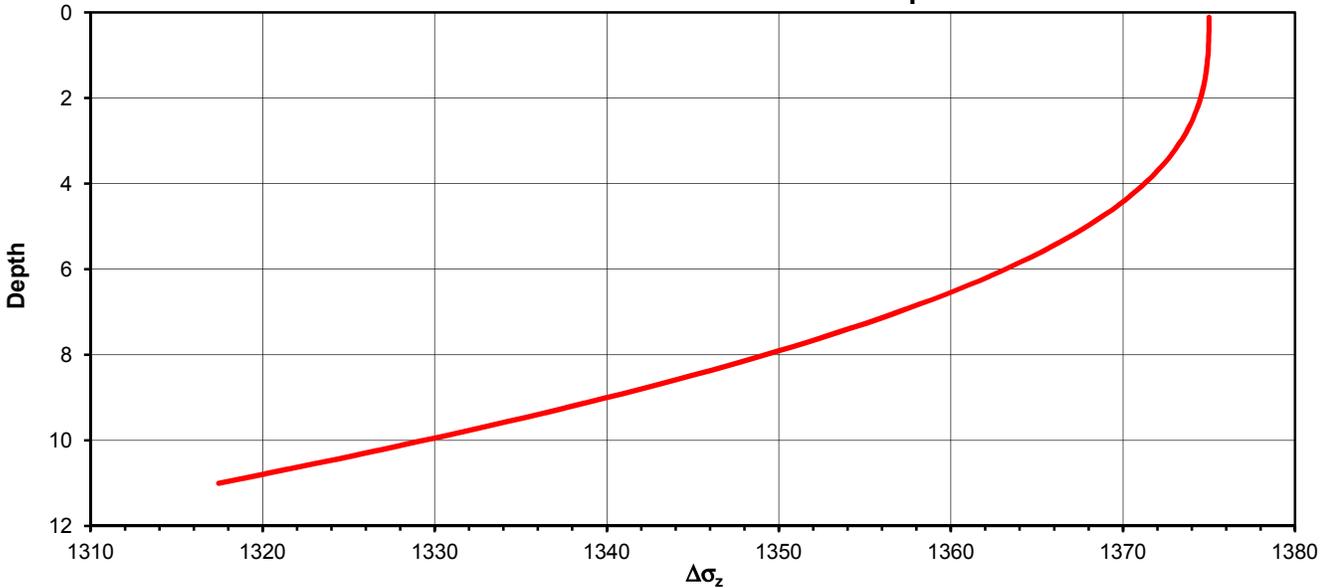
$$\sigma_v(z) := \left(\frac{q}{\pi a}\right) (a(\alpha(z) + \beta(z) + \alpha'(z)) + b(\alpha(z) + \alpha'(z)) + x(\alpha(z) - \alpha'(z)))$$

5 Granular Fill

0 0 0

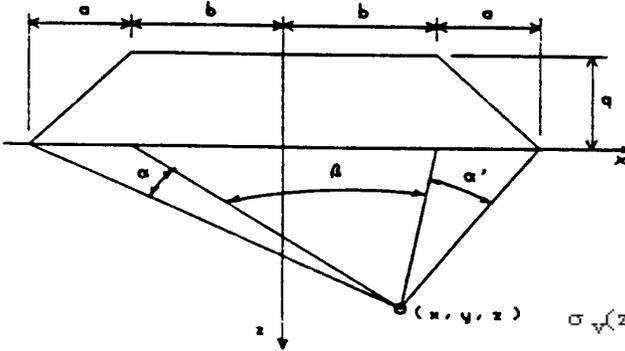
$$\beta(z) := \text{atan}\left[\frac{(b-x)}{z}\right] + \text{atan}\left[\frac{(b+x)}{z}\right]; \alpha'(z) := \text{atan}\left[\frac{(a+b-x)}{z}\right] - \text{atan}\left[\frac{(b-x)}{z}\right]; \alpha(z) := \text{atan}\left[\frac{(a+b+x)}{z}\right] - \text{atan}\left[\frac{(b+x)}{z}\right]$$

Vertical Stress Increase Vs. Depth



Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

SETTLEMENT ANALYSIS - EMBANKMENT

Embankment Informaiton:


Groundwater Table: D= 11.0 ft
 Embankment Height: H= 11 ft
 Fill Unit Weight: $\gamma_{emb} = 125$ pcf $q = 1,375$ psf
 Width of Slope: a= 20
 Top half-width of Emb: b= 14
 Distance from CL: x= 0
 Output Range: z= 0 to 11 ft

*See Data output Attached

$$\sigma_v(z) := \left(\frac{q}{\pi a} \right) (a(\alpha(z) + \beta(z) + \alpha'(z)) + b(\alpha(z) + \alpha'(z)) + x(\alpha(z) - \alpha'(z)))$$

$$\beta(z) := \text{atan} \left[\frac{(b-x)}{z} \right] + \text{atan} \left[\frac{(b+x)}{z} \right]$$

$$\alpha'(z) := \text{atan} \left[\frac{(a+b-x)}{z} \right] - \text{atan} \left[\frac{(b-x)}{z} \right]$$

$$\alpha(z) := \text{atan} \left[\frac{(a+b+x)}{z} \right] - \text{atan} \left[\frac{(b+x)}{z} \right]$$

Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

No.	Bot. of Laye	Soil Type	γ_{soil} (pcf)	σ'_c (psf)	σ'_o (psf)	$\Delta\sigma_z$ (psf)	σ'_f (psf)	Cohesionless			
								C'	C_r	C_c	e_o
1	5.0 ft	Granular Fill	130	1,755	325	1,374	1,699	250.0	0.00	0.00	0.000
2	13.0 ft	A-7-5/CH	130	3,120	1,170	1,341	2,511	0.0	0.05	0.54	0.990
3											
4											
5											
6											
7											
8											
9											
10											

No.	Settlement:	Total Settlement
1	0.014 ft	0.086 ft
2	0.072 ft	
3		1.0 in
4		
5		
6		
7		
8		
9		
10		

Reference: Geotechnical Engineering Principles and Practices; Coduto, 1999

Overconsolidated Soils - Case I ($\sigma'_o < \sigma'_c$) Eqn:11.24

$$(\delta_c)_{ult} = \sum \frac{C_r}{1+e_o} H \log \left(\frac{\sigma'_f}{\sigma'_o} \right)$$

Overconsolidated Soils - Case II ($\sigma'_o < \sigma'_c < \sigma'_f$) Eqn:11.25

$$(\delta_c)_{ult} = \sum \left[\frac{C_r}{1+e_o} H \log \left(\frac{\sigma'_c}{\sigma'_o} \right) + \frac{C_c}{1+e_o} H \log \left(\frac{\sigma'_f}{\sigma'_c} \right) \right]$$

Normally Consolidated Soils ($\sigma'_o = \sigma'_c$) Eqn: 11.23

$$(\delta_c)_{ult} = \sum \frac{C_c}{1+e_o} H \log \left(\frac{\sigma'_f}{\sigma'_o} \right)$$

Reference: FHWA NHI-00-045

Cohesionless Soils ($\sigma'_o = \sigma'_c$)

$$(\delta_c)_{ult} = \sum \frac{1}{C'} H \log \left(\frac{\sigma'_f}{\sigma'_o} \right)$$



SUBJECT

Client KYTC

JOB NUMBER

0631.006.02

Project Oldham County Underpass

SHEET NO.

OF

Item Settlement of Bridge Side Slope

COMP. BY

MDK

DATE

01/09/15

South RR Embankment

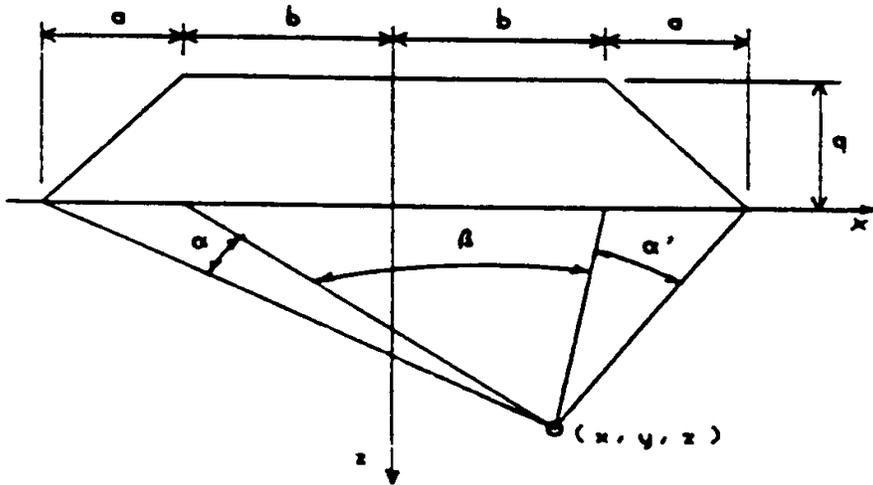
CHECKED BY

HJH

DATE

01/16/15

INCREASE IN VERTICAL STRESS DUE TO EMBANKMENT LOADING



11
 15 1375 load
 0
 45 20 width of slope
 15
 b = 14 top half-width of
 13 embankment
 x = 0 distance from CL
 z = 0 to 11 depth range

$$\sigma_v(z) := \left(\frac{q}{\pi a}\right) (a(\alpha(z) + \beta(z) + \alpha'(z)) + b(\alpha(z) + \alpha'(z)) + x(\alpha(z) - \alpha'(z)))$$

5 Granular Fill

##

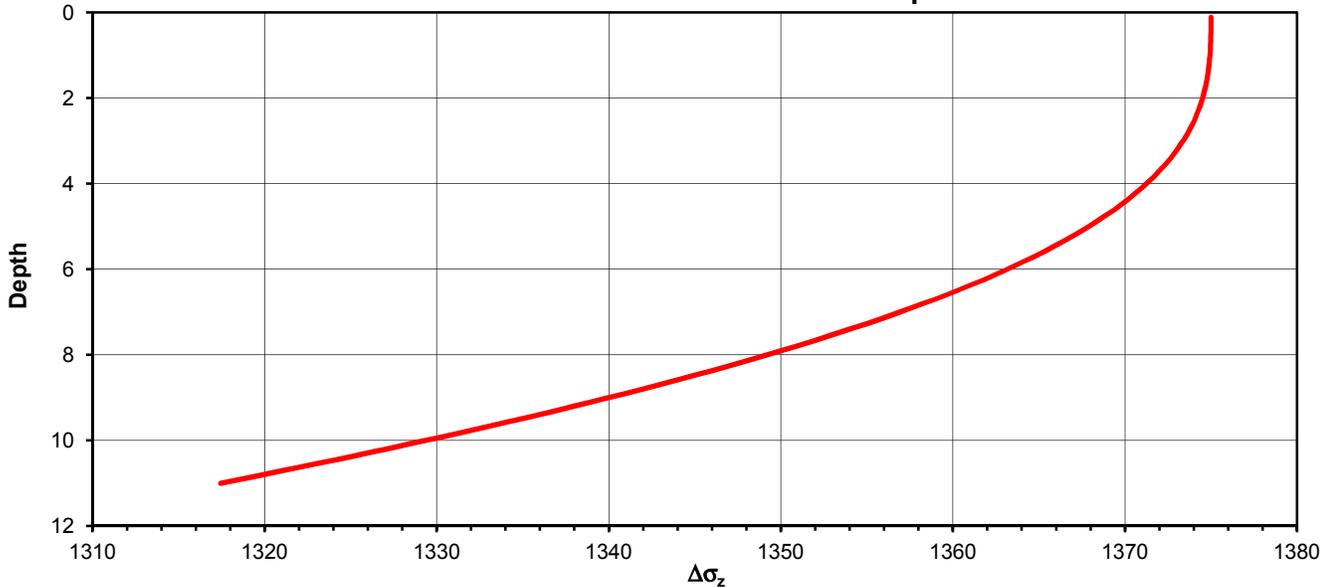
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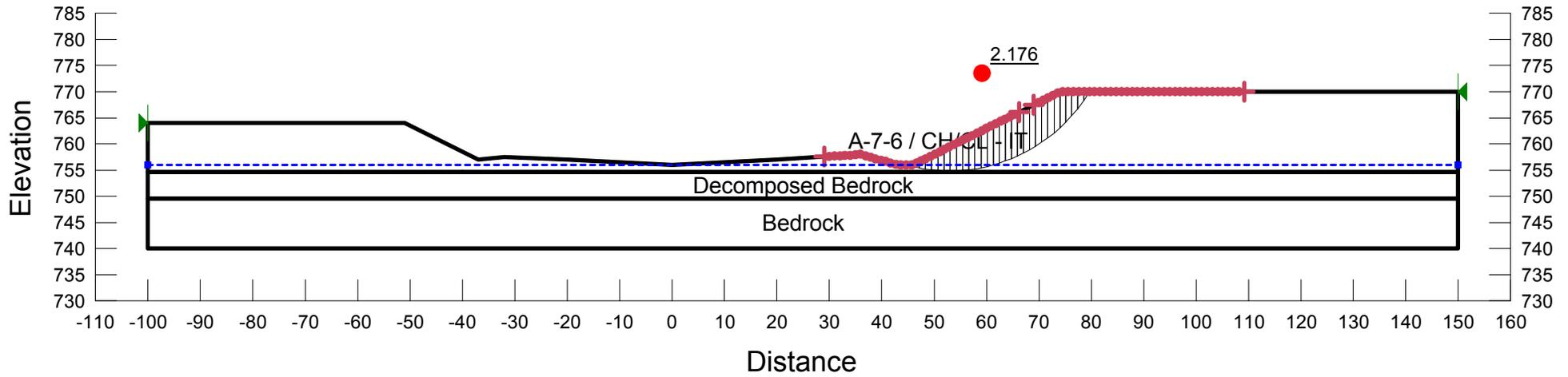
$$\beta(z) := \text{atan}\left[\frac{(b-x)}{z}\right] + \text{atan}\left[\frac{(b+x)}{z}\right]; \quad \alpha'(z) := \text{atan}\left[\frac{(a+b-x)}{z}\right] - \text{atan}\left[\frac{(b-x)}{z}\right]; \quad \alpha(z) := \text{atan}\left[\frac{(a+b+x)}{z}\right] - \text{atan}\left[\frac{(b+x)}{z}\right]$$

Vertical Stress Increase Vs. Depth



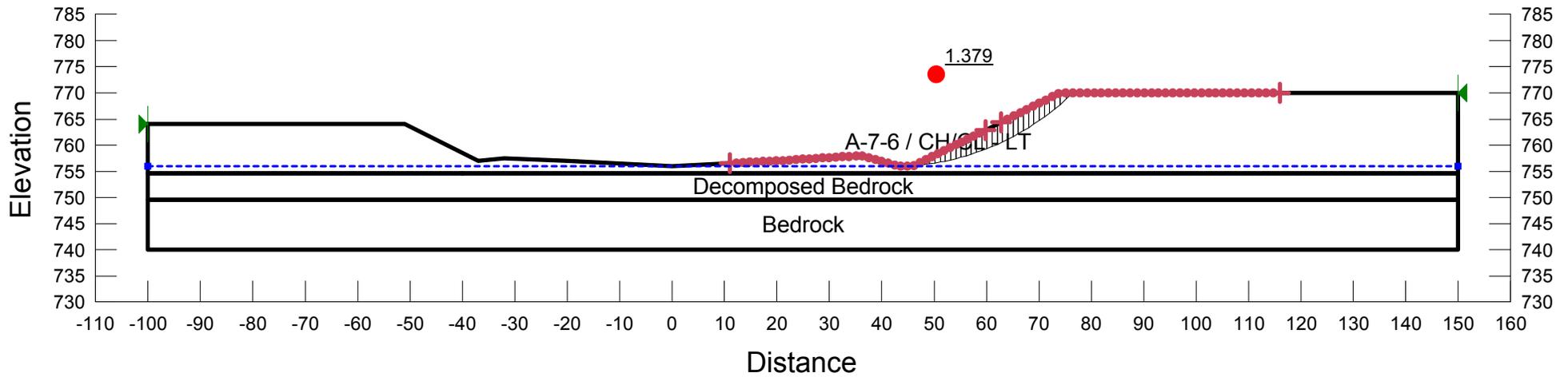
Reference: US Army Corps of Engineers EM 1110-1-1904 "Settlement Analysis", Table C-1

Allen Lane Stability
Intermediate Term



Name: Bedrock Model: Bedrock (Impenetrable)
Name: Decomposed Bedrock Model: Mohr-Coulomb Unit Weight: 145 pcf Cohesion': 0 psf Phi': 40 °
Name: A-7-6 / CH/CL - IT Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 200 psf Phi': 26 °

Side Slope Fill - Structure Slope Stability
Long Term

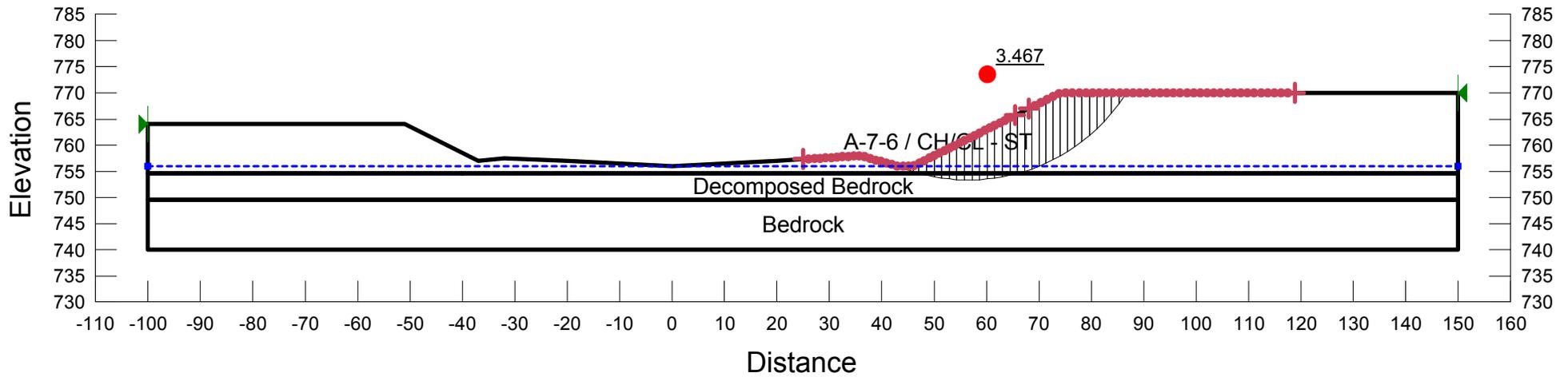


Name: Bedrock Model: Bedrock (Impenetrable)

Name: A-7-6 / CH/CL - LT Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 40 psf Phi': 26 °

Name: Decomposed Bedrock Model: Mohr-Coulomb Unit Weight: 145 pcf Cohesion': 0 psf Phi': 40 °

Side Slope Fill - Structure Slope Stability
Short Term

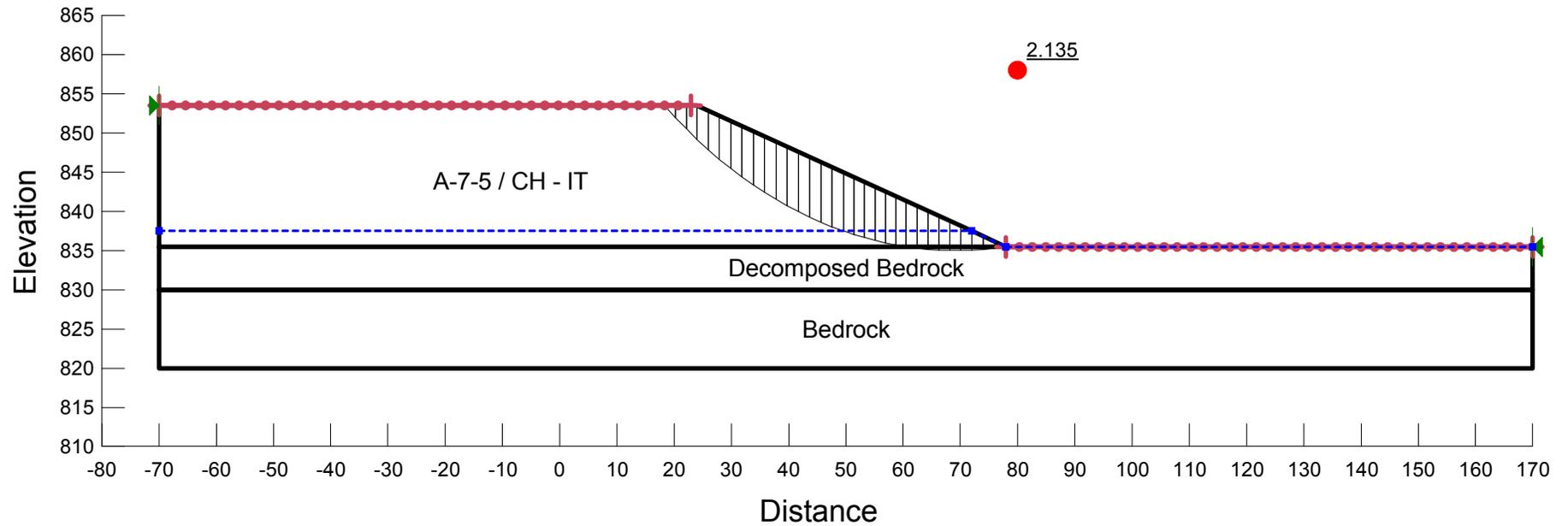


Name: Bedrock Model: Bedrock (Impenetrable)

Name: A-7-6 / CH/CL - ST Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 1,000 psf Phi': 0 °

Name: Decomposed Bedrock Model: Mohr-Coulomb Unit Weight: 145 pcf Cohesion': 0 psf Phi': 40 °

Cut Stability for Grade Separation Outside Structural Limits
Intermediate Term

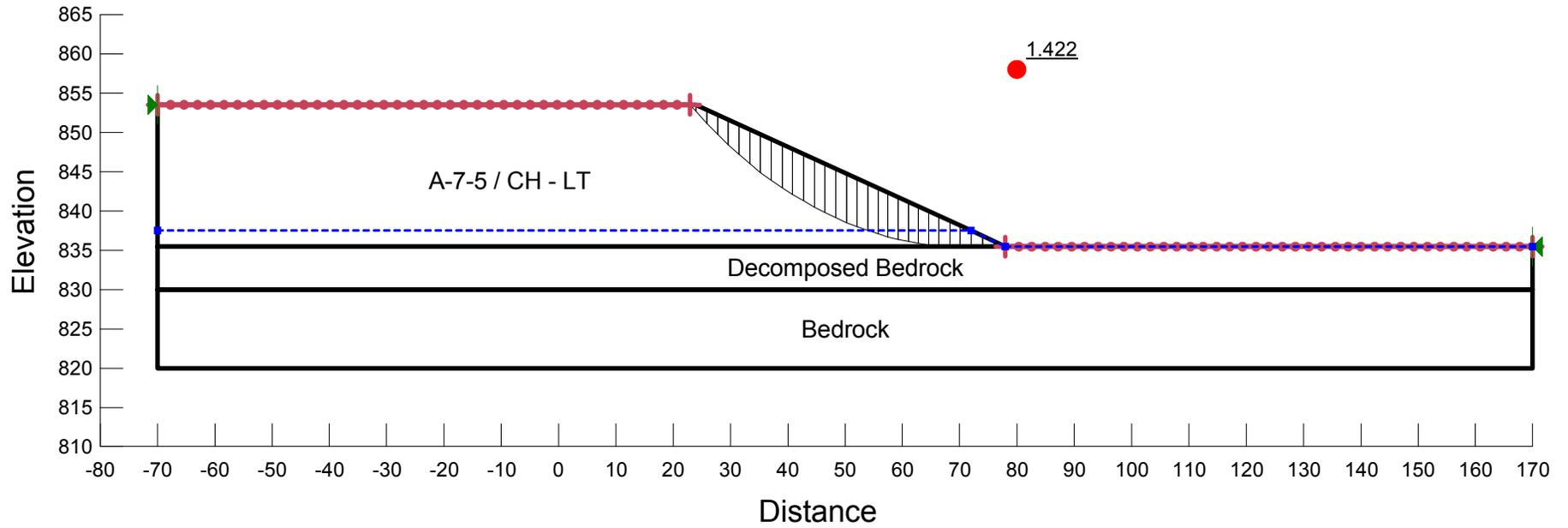


Name: Bedrock Model: Mohr-Coulomb Unit Weight: 145 pcf Cohesion': 6,000 psf Phi': 40 °

Name: Decomposed Bedrock Model: Mohr-Coulomb Unit Weight: 145 pcf Cohesion': 0 psf Phi': 40 °

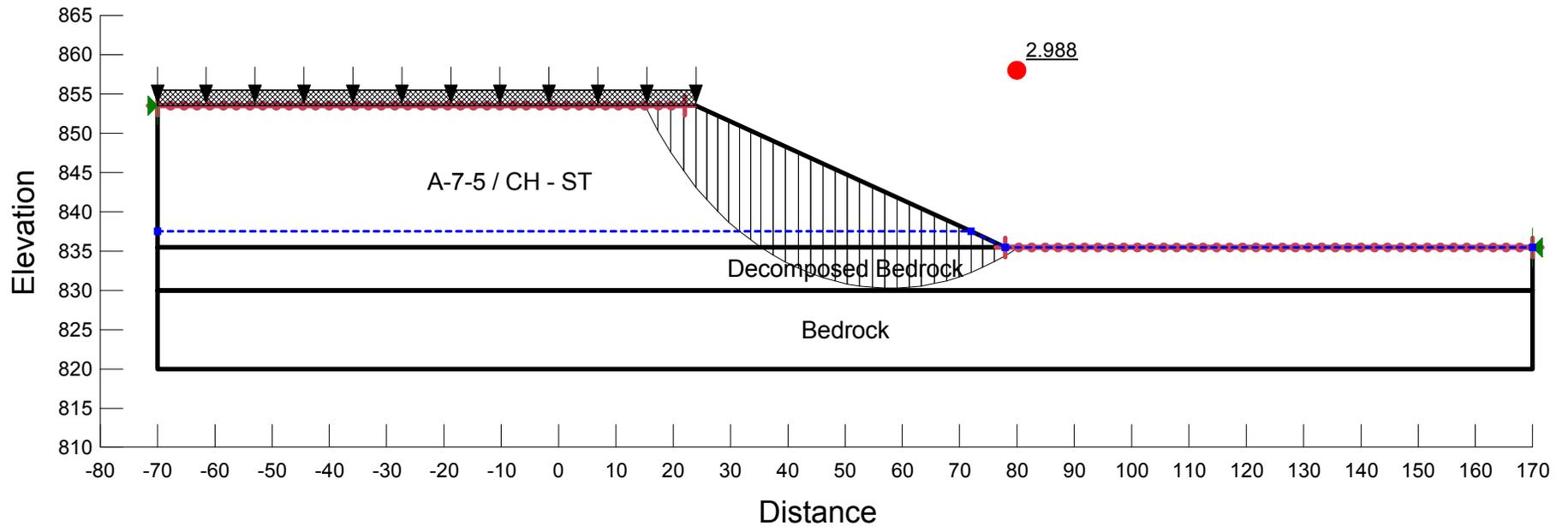
Name: A-7-5 / CH - IT Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 200 psf Phi': 20 °

Cut Stability for Grade Separation Outside Structural Limits
Long Term



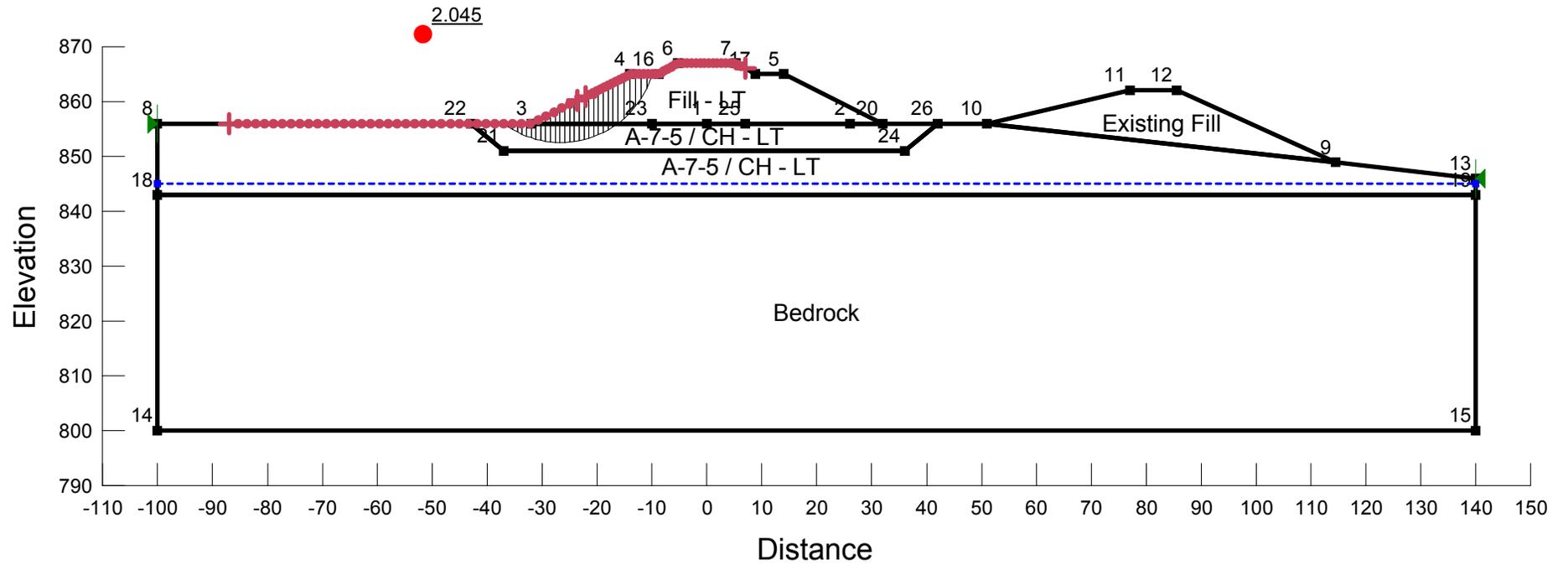
Name: Bedrock Model: Mohr-Coulomb Unit Weight: 145 pcf Cohesion': 6,000 psf Phi': 40 °
 Name: A-7-5 / CH - LT Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 40 psf Phi': 20 °
 Name: Decomposed Bedrock Model: Mohr-Coulomb Unit Weight: 145 pcf Cohesion': 0 psf Phi': 40 °

Cut Stability for Grade Separation Outside Structural Limits
Short Term



Name: Bedrock Model: Mohr-Coulomb Unit Weight: 145 pcf Cohesion': 6,000 psf Phi': 40 °
 Name: A-7-5 / CH - ST Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 1,000 psf Phi': 0 °
 Name: Decomposed Bedrock Model: Mohr-Coulomb Unit Weight: 145 pcf Cohesion': 0 psf Phi': 40 °

Rail Road Runaround Embankment Stability
Long Term



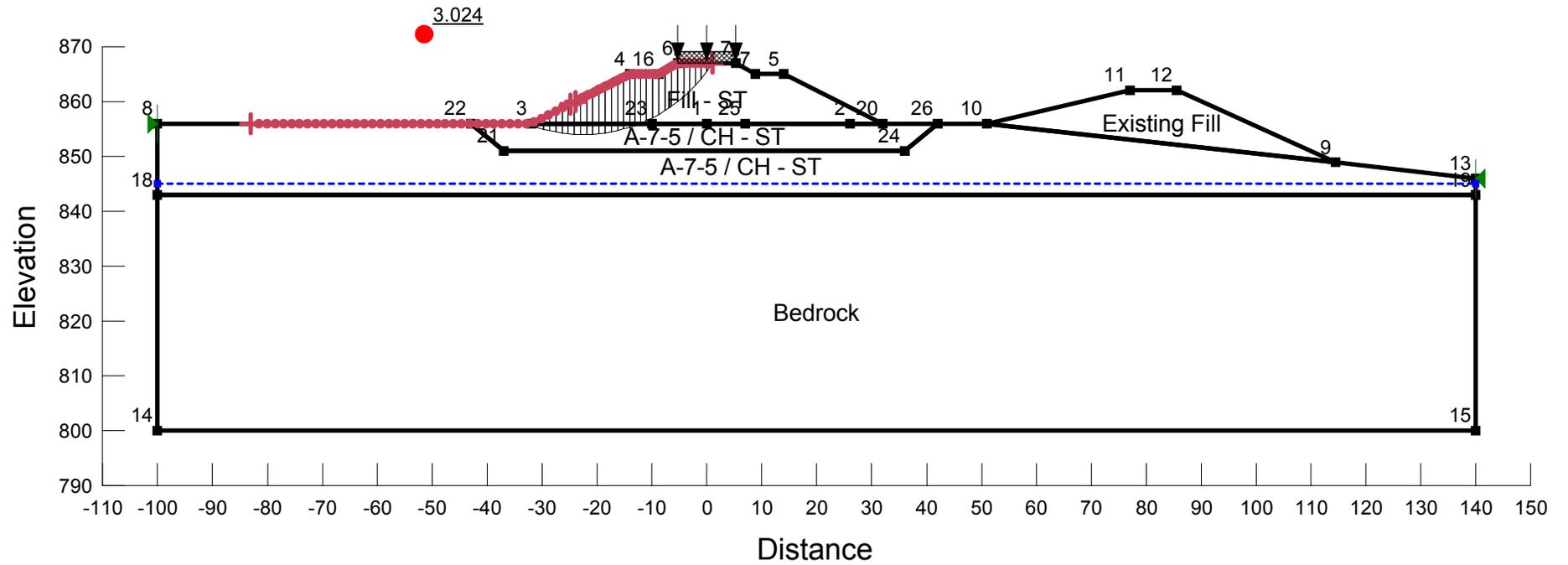
Name: Bedrock Model: Bedrock (Impenetrable)

Name: Fill - LT Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 270 psf Phi': 28 °

Name: A-7-5 / CH - LT Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 40 psf Phi': 20 °

Name: Existing Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 °

Rail Road Runaround Embankment Stability
Short Term



Name: Bedrock Model: Bedrock (Impenetrable)

Name: Fill - ST Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 1,500 psf Phi': 0 °

Name: A-7-5 / CH - ST Model: Mohr-Coulomb Unit Weight: 130 pcf Cohesion': 1,000 psf Phi': 0 °

Name: Existing Fill Model: Mohr-Coulomb Unit Weight: 125 pcf Cohesion': 0 psf Phi': 30 °

APPENDIX IV

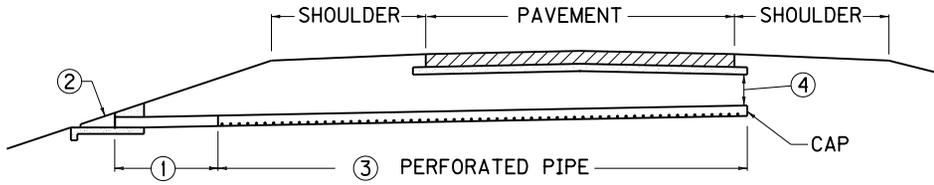
KYTC Standard Drawings

RDP-005

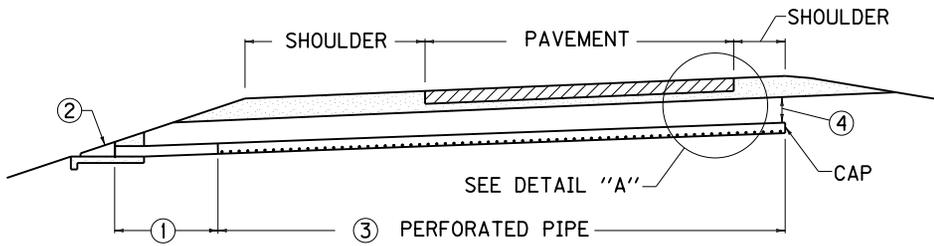
RDP-006

RGX-010

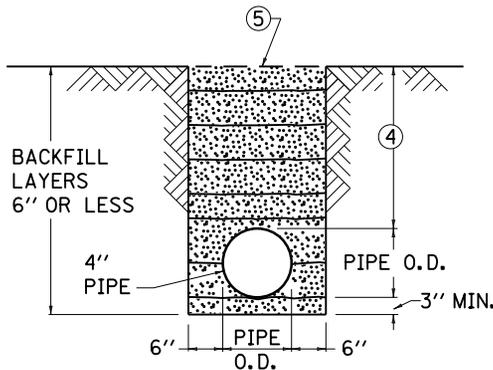
TYPICAL SUBGRADE DRAINAGE LOCATIONS



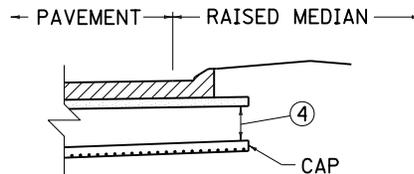
TANGENT SECTION - TWO LANE



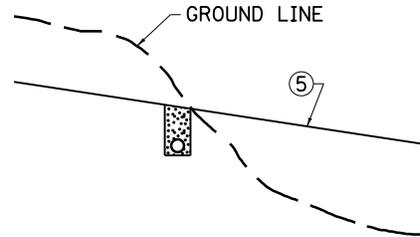
TANGENT SECTION - MULTI LANE



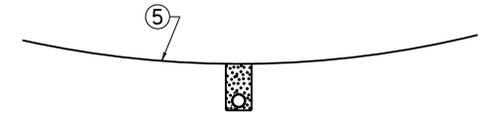
TRENCH DETAIL



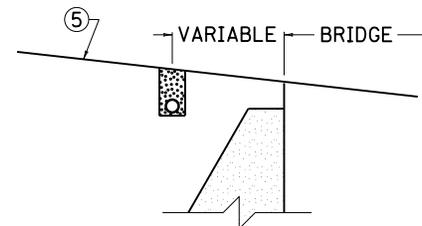
RAISED MEDIAN
DETAIL "A"



CUT TO FILL



SAG VERTICAL CURVES



SUBGRADE DRAINAGE SHALL BE INSTALLED AT UPGRADE END OF BRIDGE ONLY.

BRIDGES

NOTES

SUBGRADE DRAINAGE, AS DEPICTED, IS INTENDED FOR USE WITH THE SURFACING PHASE OF CONSTRUCTION, AND SHALL BE INSTALLED ONLY AFTER THE SUBGRADE HAS BEEN COMPLETED, AND PRIOR TO CONSTRUCTING PAVING MATERIALS.

SUBGRADE DRAINAGE WILL NOT BE REQUIRED WHEN:
 a. ROCK SUBGRADE OR NATURAL BANK GRAVEL IS SPECIFIED.
 b. POROUS OR FREE DRAINING SUBGRADES ARE EVIDENT.
 c. DIRECTED BY THE ENGINEER.

THE CAP SHALL BE A STANDARD MANUFACTURED ITEM FURNISHED BY PIPE SUPPLIER.

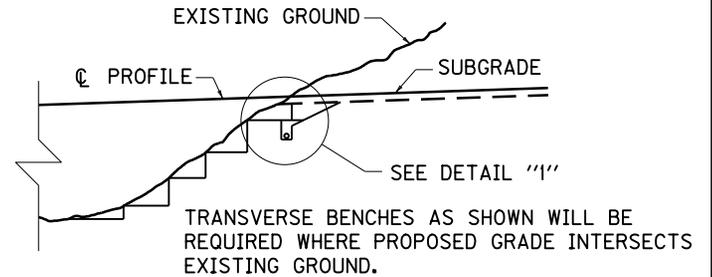
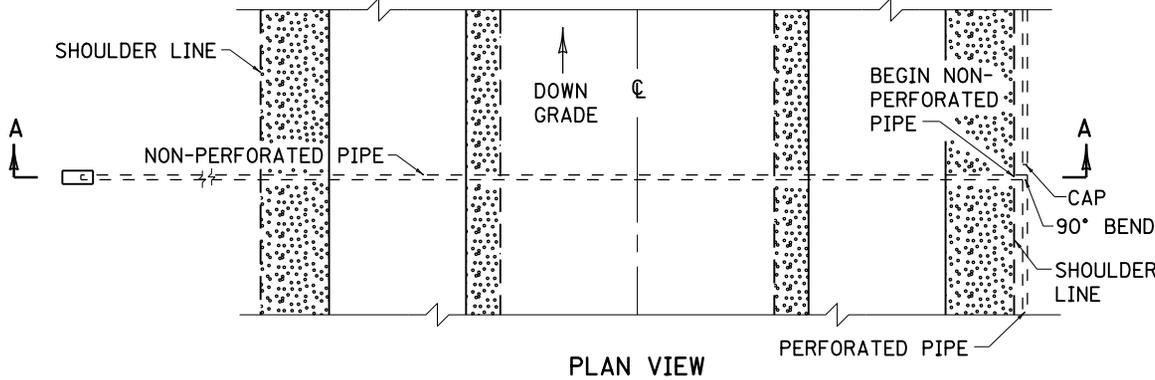
- ① APPROXIMATELY 8 TO 12 FEET OF PIPE AT THE OUTLET SHALL BE NON-PERFORATED PIPE MEETING THE REQUIREMENTS OF THE PERFORATED PIPE, EXCEPT FOR PERFORATIONS.
- ② PERFORATED PIPE HEADWALL REQUIRED AT OUTLET. SEE CUR. STD. DWG. RDP-O10.
- ③ SEE CURRENT STANDARD DRAWING RDP-001 FOR ALTERNATES.
- ④ PIPE COVER: 2'-0" DESIREABLE MINIMUM, 1'-0" ABSOLUTE MINIMUM.
FLOW SHALL BE DIRECTED TOWARD THE FILL SIDE OF THE ROADWAY WHEN POSSIBLE.
- ⑤ SUBGRADE ELEVATION.

USE WITH CUR. STD. DWGS. RDP-001 AND RDP-O10

KENTUCKY DEPARTMENT OF HIGHWAYS PERFORATED PIPE FOR SUBGRADE DRAINAGE ON TWO-LANE (CLASS 2) AND MULTI-LANE ROADS STANDARD DRAWING NO. RDP-005-04	
SUBMITTED	DATE
APPROVED	DATE

DETAIL FOR LONGITUDINAL UNDERDRAINS

DETAIL FOR TRANSVERSE UNDERDRAIN CUT TO FILL CONDITION

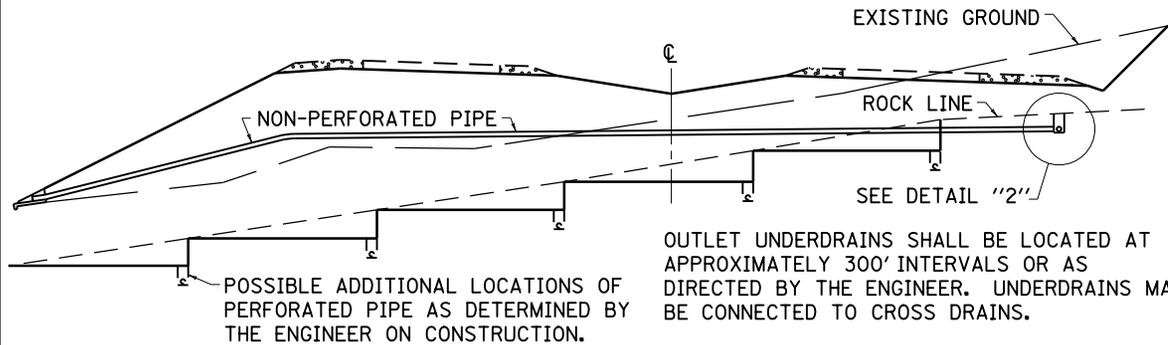


THE EXCAVATION NECESSARY TO FORM THE BENCHES SHALL BE PAID FOR AT THE CONTRACT UNIT PRICE BID FOR ROADWAY EXCAVATION.

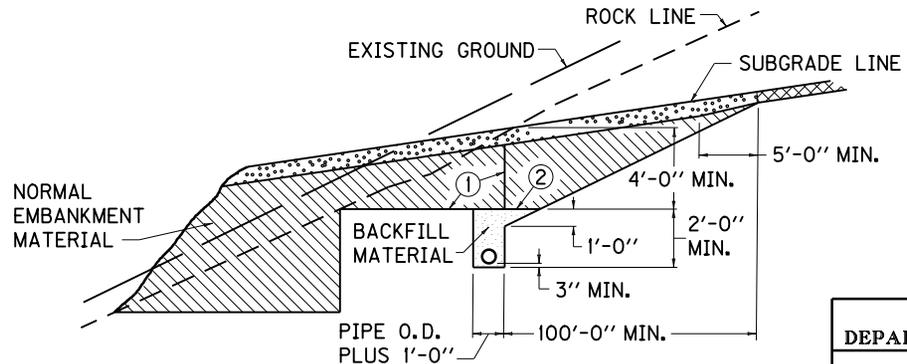
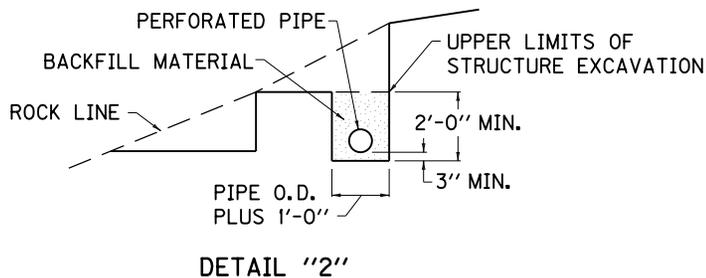
UNDERDRAINS WILL BE REQUIRED ON UPGRADE BENCH. THIS PERFORATED PIPE UNDERDRAIN SHOULD BE PLACED IN ROCK OR SHALE FORMATIONS IF POSSIBLE. PLAN LOCATIONS ARE FOR ESTIMATING PURPOSES ONLY. EXACT LOCATIONS TO BE DETERMINED BY THE ENGINEER ON CONSTRUCTION. THE FOOTAGE THUS INSTALLED SHALL BE PAID FOR AT THE CONTRACT UNIT PRICE PER LINEAR FOOT FOR PERFORATED PIPE WHICH SHALL CONSTITUTE FULL COMPENSATION FOR FURNISHING AND INSTALLING PIPE INCLUDING ALL CONNECTIONS, FITTINGS, FURNISHING AND PLACING AGGREGATE, PLACING BACKFILL, AND FURNISHING ALL LABOR AND TOOLS NECESSARY TO COMPLETE THE WORK.

EXCAVATION FOR BOTH THE PERFORATED AND NON-PERFORATED PIPE SHALL BE MEASURED AND PAID FOR AT THE UNIT PRICE AS SET FORTH IN THE STANDARD SPECIFICATIONS.

BENCHING SHALL BE REQUIRED AT ALL TRANSITIONS FROM ROCK CUTS TO FILL WHETHER OR NOT UNDERDRAIN IS REQUIRED.



SECTION A-A



NOTES

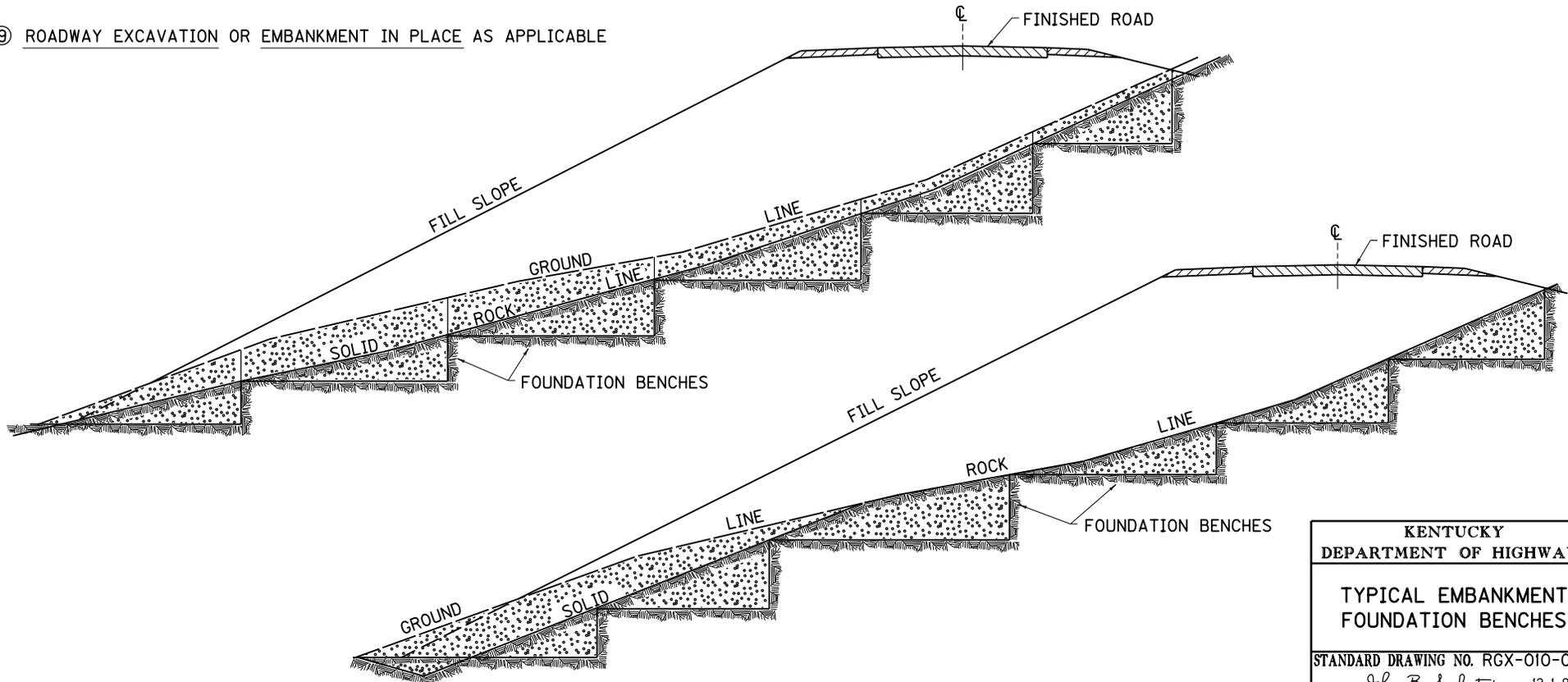
- ① LIMITS OF FIRST BENCH.
 - ② UPPER LIMITS OF STRUCTURE EXCAVATION.
- ALL PERFORATED PIPE SHALL COMPLY WITH THE STANDARD SPECIFICATIONS.
ALL NON-PERFORATED PIPE SHALL BE THE SAME TYPE AS THE PERFORATED PIPE, EXCEPT WITHOUT PERFORATIONS.

KENTUCKY DEPARTMENT OF HIGHWAYS		
PERFORATED PIPE UNDERDRAINS		
STANDARD DRAWING NO. RDP-006-03		
SUBMITTED	<i>David Kott</i> DIRECTOR DIVISION OF DESIGN	11-21-07 DATE
APPROVED	<i>November Mathews</i> STATE HIGHWAY ENGINEER	11-21-07 DATE

TYPICAL EMBANKMENT FOUNDATION BENCHES

1. THIS TREATMENT FOR EMBANKMENT FOUNDATION BENCHES AS INDICATED ON THIS SHEET, SHALL BE ACCEPTED AS GUIDES FOR HIGHWAY DESIGN, HOWEVER, ALL THE CONDITIONS THAT WILL BE ENCOUNTERED CANNOT BE SHOWN, SO THE DESIGNER MUST GIVE CONSIDERABLE THOUGHT TO THE LOCATIONS AND DIMENSIONS OF THESE BENCHES.
2. DEFINITE DESIGN INFORMATION CANNOT BE ESTABLISHED AS TO SIZE OF THESE BENCHES, DUE TO THE IRREGULARITIES AND THE DIFFERENT RATES OF INCLINE OF THE EXISTING CROSS SECTION, HOWEVER, IT IS GENERALLY BELIEVED THAT A 6' TO 12' RISE AND A 20' TO 35' HORIZONTAL RUN IS FAIRLY TYPICAL WITH A 15' HORIZONTAL RUN BEING THE MINIMUM.
3. WHEN THE INCLINE OF THE CROSS SECTION IS 15 PERCENT OR GREATER THESE EMBANKMENT FOUNDATION BENCHES SHALL BE CONSTRUCTED IN THE ORIGINAL SLOPE AS THE EMBANKMENT IS CONSTRUCTED IN COMPACTED LAYERS OR LIFTS.
4. WHEN EMBANKMENT FOUNDATION BENCHES ARE SHOWN ON THE CROSS SECTION, THE VOLUME SHALL BE COMPUTED AS ROADWAY EXCAVATION OR EMBANKMENT IN PLACE AS APPLICABLE AND SHOWN IN THE SHEET TOTALS AND BROUGHT FORWARD TO BE INCLUDED IN THE TOTAL EARTHWORK WITH THIS NOTE "⑨ TOTAL INCLUDES "X" NUMBER OF CUBIC YARDS FROM EMBANKMENT FOUNDATION BENCHES."
5. THE EXCAVATION FROM THESE BENCHES WILL NOT BE SHOWN IN THE DISTRIBUTION OF QUANTITIES BUT THEY WILL DEFINITELY BE A PAY QUANTITY BY VIRTUE OF THE FACT THEY ARE INCLUDED IN THE TOTAL OF ROADWAY EXCAVATION QUANTITIES.
6. NO QUANTITIES WILL BE ALLOWED FOR THE REFILLING OF THESE BENCHES, SINCE SUPPOSEDLY, THE MATERIAL THAT WAS EXCAVATED WILL BE PROCESSED AND PLACED BACK IN THESE BENCHES.
7. IF THE CROSS SECTION IS AN EARTH ONE, THAT IS IF NO ROCK IS SHOWN, THEN THE FOUNDATION BENCHES SHALL BE INDICATED ON THE CROSS SECTION AND CONSTRUCTED AS SHOWN BY THE DRAWING AND THE VOLUME OF EXCAVATION BECOMES A PAY ITEM AS ROADWAY EXCAVATION OR EMBANKMENT IN PLACE AS APPLICABLE, IN OTHER WORDS, SUPPORT BENCHING OF EARTH SECTIONS SHALL BE GIVEN SAME TREATMENT AS ROCK OR NEAR ROCK SECTION.
8. SHOULD IT BE EVIDENT, AT THE TIME OF CONSTRUCTION, THAT THE ENGINEER FINDS AND SO DIRECTS THAT EMBANKMENT FOUNDATION BENCHING IS NECESSARY AND IT IS NOT SO INDICATED ON THE DESIGN CROSS SECTIONS THE BASIS OF PAYMENT SHALL BE AS HEREIN BEFORE STATED.

⑨ ROADWAY EXCAVATION OR EMBANKMENT IN PLACE AS APPLICABLE



KENTUCKY DEPARTMENT OF HIGHWAYS	
TYPICAL EMBANKMENT FOUNDATION BENCHES	
STANDARD DRAWING NO. RGX-010-03	
SUBMITTED <i>John B. Sackett</i> <small>DIRECTOR DIVISION OF DESIGN</small>	12-1-99 <small>DATE</small>
APPROVED <i>J. M. Powell</i> <small>STATE HIGHWAY ENGINEER</small>	12-1-99 <small>DATE</small>

APPENDIX V

Soil Profile Sheets and Stability Analysis Sheets

GEOTECHNICAL SYMBOLS

COUNTY OF	ITEM NO.	SHEET NO.
OLDHAM	5-434.00	001

AASHTO Classification of Soils and Soil-Aggregate Mixtures

General Classification	Granular Materials (35% or less passing 0.075 mm)						Silt-Clay Materials (More than 35% passing 0.075 mm)			
	A-1		A-3	A-2			A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6				
Sieve Analysis, Percent Passing										
2.00 mm (No. 10)	50 max	---	---	---	---	---	---	---	---	---
0.425 mm (No. 40)	30 max	50 max	51 min	---	---	---	---	---	---	---
0.075 mm (No. 200)	15 max	25 max	10 max	35 max	35 max	35 max	35 max	36 min	36 min	36 min
Characteristics of Fraction Passing 0.425 mm (No. 40)										
Liquid Limit	---	---	40 max	41 min	40 max	41 min	40 max	41 min	40 max	41 min
Plasticity Index	6 max	N.P.	10 max	10 max	11 min	11 min	10 max	10 max	11 min	11 min

- AI Activity Index
 - LI Liquidity Index
 - S+C Silt + Clay (% finer than No.200 Sieve)
 - Rockline Soundings
 - ⊖ Disturbed Sample Boring
 - ⊙ Undisturbed Sample Boring
 - ⦿ Undisturbed Sample Boring & Rock Core
 - Rock Core
 - ⊗ Slope inclinometer Installation
- typical applications:
- OW Observation Well
 - ➔ Approximate Footing Elevation
 - ▼ (Date) Water Elevation

- VS (psf) Field Vane Shear Strength
- Thin-walled Tube Sample
- < Standard Penetration Test Sample
- N Penetration Resistance
- Qu (psf) Unconfined Compressive Strength
- UU (psf) Unconsolidated Undrained Triaxial Strength
- w% Moisture Content
- KY RQD Rock Quality Designation (Kentucky Method)
- STD RQD Rock Quality Designation (Standard Method)
- SDI(JS) Slake Durability Index (Jar Slake Test)
- REC Core Recovery
- ∅ Angle of Internal Friction (Total Stress)
- ∅̄ Angle of Internal Friction (Effective Stress)
- c (psf) Cohesion (Total Stress)
- c̄ (psf) Cohesion (Effective Stress)
- γ Total Unit Weight
- RDZ Rock Disintegration Zone
- OB Overburden Bench
- IB Intermediate Bench
- R Refusal
- NR Refusal Not Encountered

Unified Soil Classifications

Unified Soil Classifications - Continued

MAJOR DIVISIONS	SYMBOL	NAME
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GM Silty gravels, gravel-sand-silt mixtures.
		GC Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW Well graded sands or gravelly sands, little or no fines.
		SP Poorly graded sands or gravelly sands, little or no fines.
		SM Silty sands, sand-silt mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS LL IS LESS THAN 50	ML Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	SILTS AND CLAYS LL IS GREATER THAN 50	ML-CL Silty clay-silty clay with sand and or gravel, sandy silty clay, sandy silty clay with gravel, gravelly silty clay, gravelly silty clay with sand
MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.		
CH Inorganic clays of high plasticity, fat clays.		

MAJOR DIVISIONS	SYMBOL	NAME
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GP-GC Poorly graded gravel with clay (or silty clay), poorly graded gravel with clay and sand (or silty clay & sand)
		GP-GM Poorly graded gravel with silt, poorly graded gravel with silt and sand
		GW-GC Well graded gravel with clay (or silty clay), well graded gravel with clay and sand (or silty clay and sand)
		GW-GM Well graded gravel with silt, well graded gravel with silt and sand
		GC-GM Silty clayey gravel, silty clayey gravel with sand
	SAND AND SANDY SOILS	SW-SC Well graded sand with clay (or silty clay), well graded sand with clay and gravel (or silty clay & gravel)
		SP-SC Poorly graded sand with clay (or silty clay), poorly graded sand with clay and gravel (or silty clay and gravel)
		SP-SM Poorly graded sand with silt, poorly graded sand with silt and gravel
		SC-SM Silty clayey sand, silty clayey sand with gravel
		SW-SM Well graded sand with silt, well graded sand with silt and gravel
UNCLASSIFIED MATERIAL	OH Organic (High Plasticity)	
	OL Organic (Low Plasticity)	

- LIMESTONE
- SANDSTONE
- DURABLE SHALE (SDI ≥ 95)
- NONDURABLE SHALE (SDI < 95)
- GRANULAR EMBANKMENT
- STRUCTURE GRANULAR BACKFILL
- TALUS, MINE WASTE, FILL MATERIAL, BOULDERS, & ETC.
- COAL
- DOLOMITE
- LIMESTONE (ARGILLACEOUS)
- SLOPE PROTECTION

FILE NAME: M:\PROJ\0631\0006\02\CADD\SHEETS\ROADWAY\RO010A01.DGN
 USER: mkennedy
 DATE PLOTTED: September 3, 2015
 MicroStation v8.11.9.357

GEOTECHNICAL NOTES

1.) CLEARING AND GRUBBING OF EMBANKMENT AREAS SHALL BE COMPLETED IN ACCORDANCE WITH SECTION 202 OF THE CURRENT KENTUCKY TRANSPORTATION CABINET (KYTC) STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION.

2.) REMOVAL OF EXISTING STRUCTURES AND OTHER OBSTRUCTIONS, WHETHER SHOWN ON THE PLANS OR NOT, SHALL BE COMPLETED IN ACCORDANCE WITH SECTION 203 OF THE CURRENT KYTC STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION.

3.) IF APPLICABLE, ALL WATER WELLS WITHIN THE LIMITS OF CONSTRUCTION, WHETHER SHOWN ON THE PLANS OR NOT, SHALL BE PLUGGED IN ACCORDANCE WITH REQUIREMENTS OF SECTION 708 OF THE CURRENT KYTC STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION.

4.) IF APPLICABLE, ALL CATCH BASINS AND MANHOLES SHALL BE FILLED AND CAPPED, AND ALL SEPTIC TANKS, IF ANY, SHALL BE CLEANED AND FILLED IN ACCORDANCE WITH SECTION 708 OF THE CURRENT KYTC STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION.

5.) ANY DRAINAGE SWALES, SATURATED, SOFT AND UNSTABLE AREAS ENCOUNTERED WITHIN PROPOSED EMBANKMENT FOUNDATION LIMITS AND/OR ANY OTHER AREAS AS SPECIFIED BY THE ENGINEER SHALL BE STABILIZED WITH A MINIMUM OF TWO FEET (VERTICAL THICKNESS) OF GRANULAR MATERIALS (KYTC COARSE AGGREGATE NO. 2) IN ACCORDANCE WITH SECTION 805 OF THE CURRENT KYTC STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, AND THE MATERIALS SHALL BE CLASSIFIED AS NON-ERODIBLE, AS DIRECTED BY THE ENGINEER. ADDITIONAL GRANULAR MATERIAL MAY BE REQUIRED TO STABILIZE THE EMBANKMENT FOUNDATIONS AND TO MAINTAIN POSITIVE DRAINAGE. THE ACTUAL THICKNESS AND LOCATIONS OF GRANULAR MATERIAL SHALL BE DETERMINED BY THE ENGINEER DURING CONSTRUCTION. THE GRANULAR MATERIALS SHALL BE WRAPPED (TOP AND BOTTOM) WITH TYPE IV GEOTEXTILE FABRIC IN ACCORDANCE WITH SECTIONS 214 AND 843 OF THE CURRENT STANDARD SPECIFICATIONS. POSITIVE DRAINAGE SHALL BE MAINTAINED TO PREVENT TRAPPING WATER WITHIN THE ROADWAY EMBANKMENT.

6.) ANY PONDS LYING WITHIN THE STAKED CONSTRUCTION LIMITS SHALL BE DRAINED, CLEANED OUT, AND FILLED IN ACCORDANCE WITH SECTION 206 OF THE CURRENT KYTC STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION. NORMALLY, A MINIMUM OF THREE FEET (VERTICAL THICKNESS) OF KYTC COARSE AGGREGATE NO. 2 OR SHOT ROCK OF SIMILAR SIZE, QUALITY, AND GRADATION APPROVED BY THE ENGINEER IS USED FOR STABILIZATION. A RETENTION POND PRESENTLY EXISTS AT APPROXIMATELY 50 FEET EAST OF EXISTING ALLEN LANE AND APPROXIMATELY 150 FEET SOUTH OF ARTISAN PARKWAY (APPROXIMATELY STA. 161+00). THIS EXISTING RETENTION POND MAY BE IMPACTED IF ADDITIONAL RIGHT-OF-WAY IS REQUIRED. DETAILED DIMENSIONS OF ANY IMPACTED PONDS SHALL BE DETERMINED PRIOR TO CONSTRUCTION FOR CALCULATING BACKFILLING QUANTITIES.

7.) THE CONTRACTOR IS RESPONSIBLE FOR CONDUCTING ANY OPERATIONS NECESSARY IN ORDER TO EXCAVATE THE CUT AREAS TO THE REQUIRED TYPICAL SECTIONS. THESE OPERATIONS SHALL BE INCIDENTAL TO THE ROADWAY EXCAVATION PRICE.

8.) THE CONTRACTOR SHALL CONDUCT GRADING OPERATIONS IN SUCH A MANNER THAT BEDROCK OBTAINED FROM EXCAVATION BELOW THE BASE OF RDZ SHALL BE STOCKPILED SEPARATELY OR OTHERWISE RE-CONDITIONED SO AS TO BE AVAILABLE FOR USE IN THOSE AREAS REQUIRING SAID MATERIAL. NO DIRECT PAYMENT WILL BE ALLOWED FOR SUCH NECESSARY RE-CONDITIONING AS STOCKPILING, RE-HANDLING THE MATERIAL, AND/OR HAULING.

9.) ALL CHANNEL CHANGES, EXCAVATION OF SURFACE DITCHES, AND CONSTRUCTION OF SPECIAL DITCHES SHALL BE PERFORMED IN ACCORDANCE WITH SECTIONS 204 AND 206 OF THE CURRENT KYTC STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, PRIOR TO PLACEMENT OF ANY EMBANKMENT MATERIALS ADJACENT TO THEM. THE CONSTRUCTION OF THE EMBANKMENT SHALL BE COMPLETED IN ACCORDANCE WITH SECTION 206 OF THE CURRENT KYTC STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION. AT THE DIRECTION OF THE ENGINEER, MATERIALS EXCAVATED FROM THESE AREAS MAY BE UTILIZED IN CONSTRUCTION OF THE EMBANKMENTS, BUT MAY REQUIRE AERATION OR OTHER MOISTURE ADJUSTMENTS TO OBTAIN PROPER MOISTURE CONTENTS PRIOR TO COMPACTION OPERATIONS.

10.) FAT CLAY OR SHALE SHALL NOT BE USED IN CONSTRUCTION OF THE EMBANKMENTS.

11.) IN ACCORDANCE WITH SECTION 206 OF THE CURRENT KYTC STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, THE MOISTURE CONTENT OF EMBANKMENT MATERIAL SHALL NOT VARY FROM THE OPTIMUM MOISTURE CONTENT, AS DETERMINED BY KM 64-511, BY MORE THAN PLUS OR MINUS TWO PERCENT. THIS MOISTURE CONTENT REQUIREMENT SHALL HAVE EQUAL WEIGHT WITH THE DENSITY REQUIREMENT WHEN DETERMINING THE ACCEPTABILITY OF EMBANKMENT OR SUBGRADE CONSTRUCTION. REFER TO THE FAMILY OF CURVES FOR MOISTURE-DENSITY RELATIONSHIPS.

12.) ALL SOILS, WHETHER FROM ROADWAY EXCAVATION OR BORROW, MAY REQUIRE MOISTURE ADJUSTMENTS TO OBTAIN PROPER MOISTURE CONTENT PRIOR TO COMPACTION. DIRECT PAYMENT SHALL NOT BE PERMITTED FOR REHANDLING, HAULING, STOCKPILING AND/OR MOISTURE ADJUSTING SOILS.

13.) ALL NEW FILL MATERIALS SHALL BE FREE OF TOPSOIL, ORGANICS, DEBRIS, OR ANY DELETERIOUS MATERIAL DEEMED BY THE ENGINEER. NO FROZEN MATERIALS SHALL BE INCORPORATED INTO THE FILL, AND NO EMBANKMENT, PAVEMENT, UTILITIES, OR FILL SHALL BE PLACED ON TOP OF FROZEN MATERIALS. ONLY SUITABLE MATERIALS DEEMED BY THE ENGINEER SHALL BE USED AS NEW FILL MATERIALS.

14.) NO PARTICLE SIZE LARGER THAN FOUR INCHES IN ANY DIRECTION, UNLESS DIRECTED BY THE ENGINEER, SHALL BE PLACED AS FILL WITHIN ONE FOOT OF THE FINISHED SUBGRADE ELEVATION. ANY PARTICLE SIZE GREATER THAN FOUR INCHES SHALL BE BROKEN DOWN TO LESS THAN FOUR INCHES, OR REMOVED FROM THE LIFT.

15.) BORROW MATERIAL, IF NEEDED, USED FOR ROADWAY SUBGRADE, SHALL MEET THE MINIMUM CBR VALUE OF 2.0.

16.) WHEN ROCK, INCLUDING SHALE, IS PRESENT AT THE ROADWAY SUBGRADE, WITHIN 12 INCHES OF THE BOTTOM OF THE DGA, IT SHALL BE REMOVED IN ACCORDANCE WITH SECTION 204 OF THE CURRENT KYTC STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION AND REPLACED WITH SOIL FILL IN ACCORDANCE WITH SECTIONS 206 AND 207 OF THE CURRENT STANDARD SPECIFICATIONS.

17.) A MINIMUM ONE-FOOT WORKING PLATFORM (EXTENDING UNDER THE CURB AND GUTTER) WILL BE REQUIRED IN AREAS WHERE THE ROADWAY SUBGRADE IS SOFT AND/OR SATURATED. THE PLATFORM WILL CONSIST OF KENTUCKY COARSE AGGREGATE #2 IN ACCORDANCE WITH SECTION 805 OF THE CURRENT KYTC STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION. THE WORKING PLATFORM SHALL BE WRAPPED WITH TYPE IV GEOTEXTILE FABRIC IN ACCORDANCE WITH SECTIONS 214 AND 843 OF THE CURRENT STANDARD SPECIFICATIONS. THE ACTUAL LOCATIONS AND THICKNESS SHALL BE DETERMINED BY THE ENGINEER DURING CONSTRUCTION AND MAY DEPEND ON SEASONAL FLUCTUATIONS IN THE WATER TABLE. THE WORKING PLATFORM CAN ALSO SERVE AS A DRAINAGE BLANKET BY PLACING PERFORATED DRAIN PIPE INTO THE BOTTOM OF THE GRANULAR MATERIAL. POSITIVE DRAINAGE OF THE PERFORATED DRAIN PIPE SHALL BE MAINTAINED TO REDUCE THE POSSIBILITY OF TRAPPING WATER WITHIN THE SUBGRADE.

18.) PAVEMENT UNDERDRAINS SHALL BE PROVIDED TO REDUCE THE POSSIBILITY OF TRAPPING WATER WITHIN THE SUBGRADE.

19.) PERFORATED PIPE FOR SUBGRADE DRAINAGE SHALL BE PLACED IN THE VERTICAL SAG AT THE INTERSECTION OF ALLEN LANE AND COMMERCE PARKWAY (APPROXIMATELY STA. 138+00 OF ALLEN LANE ALIGNMENT) IN ACCORDANCE WITH THE CURRENT KYTC STANDARD DRAWING RDP-005 AND/OR AS DIRECTED BY THE ENGINEER.

20.) THE CUT SLOPES IN SOILS ALONG ALLEN LANE (BETWEEN STA. 137+75.11 AND APPROXIMATE STA. 168+00) AND COMMERCE PARKWAY SHALL BE CONSTRUCTED WITH 2H:1V OR FLATTER SLOPES AS INDICATED ON THE PROJECT PLAN. IN ADDITION TO THE CUT LIMITS IDENTIFIED ON THE PROJECT PLAN, ADDITIONAL MINOR CUTS IN SOILS (LESS THAN 4 FEET IN HEIGHT) ARE REQUIRED. FINAL SLOPES IN THE MINOR CUT AREAS (LESS THAN 4 FEET IN HEIGHT) SHALL BE NO STEEPER THAN 2H:1V, UNLESS APPROVED BY THE ENGINEER.

21.) THE CUT SLOPES IN SOILS IN THE GRADE SEPARATION AREA OUTSIDE THE PROPOSED BRIDGE LOCATION (APPROXIMATELY BETWEEN STA. 171+00 AND STA. 175+13.61 OF ALLEN LANE ALIGNMENT) SHALL BE CONSTRUCTED WITH SLOPES NO STEEPER THAN 3H:1V, UNLESS A SLOPE RETAINING SYSTEM OR OTHER SLOPE STABILIZATION APPLICATIONS ARE USED.

22.) THE CUT SLOPES IN THE ROCK DISINTEGRATION ZONES AND BEDROCK SHALL BE CONSTRUCTED WITH 2H:1V OR FLATTER SLOPES.

23.) THE FILL SLOPES ALONG ALLEN LANE AND COMMERCE PARKWAY SHALL BE CONSTRUCTED WITH 2H:1V OR FLATTER SLOPES. BENCHING REQUIRING HORIZONTAL CUTS INTO EXISTING SLOPES SHALL BE USED IN ACCORDANCE WITH THE APPLICABLE KYTC REQUIREMENTS.

24.) THE RAILROAD RUNAROUND EMBANKMENT SIDE SLOPES SHALL BE CONSTRUCTED WITH 2H:1V OR FLATTER SLOPES WITH COHESIVE SOILS WITH LOW PLASTICITY PROVIDED THE COHESIVE SOILS ARE PERMITTED FOR USE IN RAILROAD EMBANKMENT CONSTRUCTION. HIGHLY PLASTIC CLAY SOILS SHALL NOT BE USED FOR EMBANKMENT FILL. BORROW MATERIAL, IF NEEDED, USED FOR EMBANKMENT CONSTRUCTION ALONG ALLEN LANE SHALL CONSIST OF LOW SWELL POTENTIAL COHESIVE SOILS (ACCORDING TO USCS OR AASHTO SOIL CLASSIFICATION) WITH LIQUID LIMIT (AS DETERMINED BY AASHTO T-89) AND PLASTICITY INDEX (AS DETERMINED BY AASHTO T-90) LESS THAN 50 AND 30, RESPECTIVELY. ALL FILL MATERIALS SHALL BE COMPACTED IN ACCORDANCE WITH SECTION 206 OF THE CURRENT KYTC STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION. ALL FILL MATERIALS SHALL BE APPROVED BY THE ENGINEER PRIOR TO THE PLACEMENT OF FILL.

25.) EMBANKMENT STABILITY ANALYSES WERE CONDUCTED USING ESTIMATED SOIL STRENGTH PARAMETERS FOR EMBANKMENT MATERIAL. BORROW MATERIAL, IF NEEDED, USED FOR EMBANKMENT CONSTRUCTION ALONG ALLEN LANE SHALL CONSIST OF LOW SWELL POTENTIAL COHESIVE SOILS (ACCORDING TO USCS OR AASHTO SOIL CLASSIFICATION) WITH LIQUID LIMIT (AS DETERMINED BY AASHTO T-89) AND PLASTICITY INDEX (AS DETERMINED BY AASHTO T-90) LESS THAN 50 AND 30, RESPECTIVELY. ALL FILL MATERIALS SHALL BE COMPACTED IN ACCORDANCE WITH SECTION 206 OF THE CURRENT KYTC STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION. ALL FILL MATERIALS SHALL BE APPROVED BY THE ENGINEER PRIOR TO THE PLACEMENT OF FILL.

26.) EMBANKMENT FOUNDATION BENCHES ARE NOT ANTICIPATED AT THIS TIME. IF REQUESTED BY THE ENGINEER, EMBANKMENT FOUNDATION BENCHES/SLOPE SERRATIONS SHALL BE CONSTRUCTED AND PERFORATED PIPE UNDERDRAINS SHALL BE PLACED, AS APPLICABLE, IN ACCORDANCE WITH THE CURRENT KYTC STANDARD DRAWINGS RDP-006 AND RCX-010. THE BENCHES SHALL BE CONSTRUCTED ONE AT A TIME BEGINNING WITH THE LOWEST BENCH. EACH BENCH SHALL BE BACKFILLED PRIOR TO EXCAVATION OF THE NEXT BENCH. THESE PROCEDURES SHALL BE FOLLOWED TO HELP MAINTAIN STABILITY OF THE EXISTING SLOPES.

27.) TRANSVERSE BENCHING IS NOT ANTICIPATED AT THIS TIME. IF REQUESTED BY THE ENGINEER, TRANSVERSE BENCHING SHALL BE CONSTRUCTED AND PERFORATED PIPE UNDERDRAINS SHALL BE PLACED, AS APPLICABLE, IN ACCORDANCE WITH THE CURRENT KYTC STANDARD DRAWINGS AND RDP-005 AND RDP-006, AS APPLICABLE. CONTRARY TO THE STANDARD DRAWING RDP-006, TRANSVERSE BENCHES AND PERFORATED PIPE UNDERDRAINS SHALL BE INSTALLED IN BOTH UPHILL AND DOWNHILL TRANSITION AREAS BETWEEN CUTS AND FILLS. IN ADDITION, PERFORATED PIPE UNDERDRAINS SHALL BE INSTALLED IN ANY AREAS SHOWING SIGNS OF SEEPAGE DURING CONSTRUCTION, AS DIRECTED BY THE ENGINEER.

28.) PROCEDURES SHALL BE PERFORMED AS REQUIRED TO CONTROL EROSION AND SILTATION IN ACCORDANCE WITH SECTIONS 212 AND 213 OF THE CURRENT KYTC STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION.

29.) THE BEDROCK, EXCEPT FOR THOSE IN RDZ, IS STRONG DOLOMITE/LIMESTONE WITH OCCASIONAL INTERBEDDED SHALE. HARD ROCK EXCAVATION TECHNIQUES WILL LIKELY BE NECESSARY TO REMOVE THE DOLOMITE/LIMESTONE. ROCK BLASTING IS NOT PERMITTED FOR THIS PROJECT. IT IS THE CONTRACTOR'S RESPONSIBILITY TO SELECT THE APPROPRIATE AND ACCEPTABLE MEANS AND METHODS OF CONSTRUCTION AND ADEQUATE CONSTRUCTION EQUIPMENT BASED ON THE ANTICIPATED SUBSURFACE CONDITIONS AND TO PREVENT DAMAGE TO ADJACENT STRUCTURES OR FACILITIES.

30.) CONSIDERATION SHOULD BE GIVEN TO CONSTRUCTING THE PROPOSED RAILROAD EMBANKMENT AS EARLY AS POSSIBLE IN CONSTRUCTION BEFORE THE RAILROAD TRACKS ARE CONSTRUCTED. SETTLEMENT PLATFORMS ARE RECOMMENDED TO VERIFY THAT PRIMARY CONSOLIDATION OF THE FOUNDATION SOIL DUE TO THE PLACEMENT OF THE EMBANKMENT FILL IS COMPLETED PRIOR TO THE CONSTRUCTION OF THE RAILROAD TRACKS.

DATE: 09/4/2015	CHECKED BY
DESIGNED BY: E. Tse	H. J. Hughes
DETAILED BY: M. KENNEDY	
OLDHAM COUNTY FISCAL COURT	
COUNTY OLDHAM	
ROUTE	CROSSING ALLEN LANE
ITEM NUMBER	PREPARED BY
5-434.00	 DLZ KENTUCKY, INC.
	201 BRIGHTON PARK BLVD. FRANKFORT, KENTUCKY 40602 (502) 695-2300
	SHEET NO. 002 DRAWING NO.

FILE NAME: M:\PROJ\0631\0006\02\CADD\SHEETS\ROADWAY\SUBMITTALS\10-01-2015\RD020ACT.DGN

USER: mkennedy
DATE PLOTTED: October 1, 2015

MicroStation v8.11.9.357

Field Drilling and Sampling were performed in the period of SEPTEMBER, 2014 to, DECEMBER, 2014.

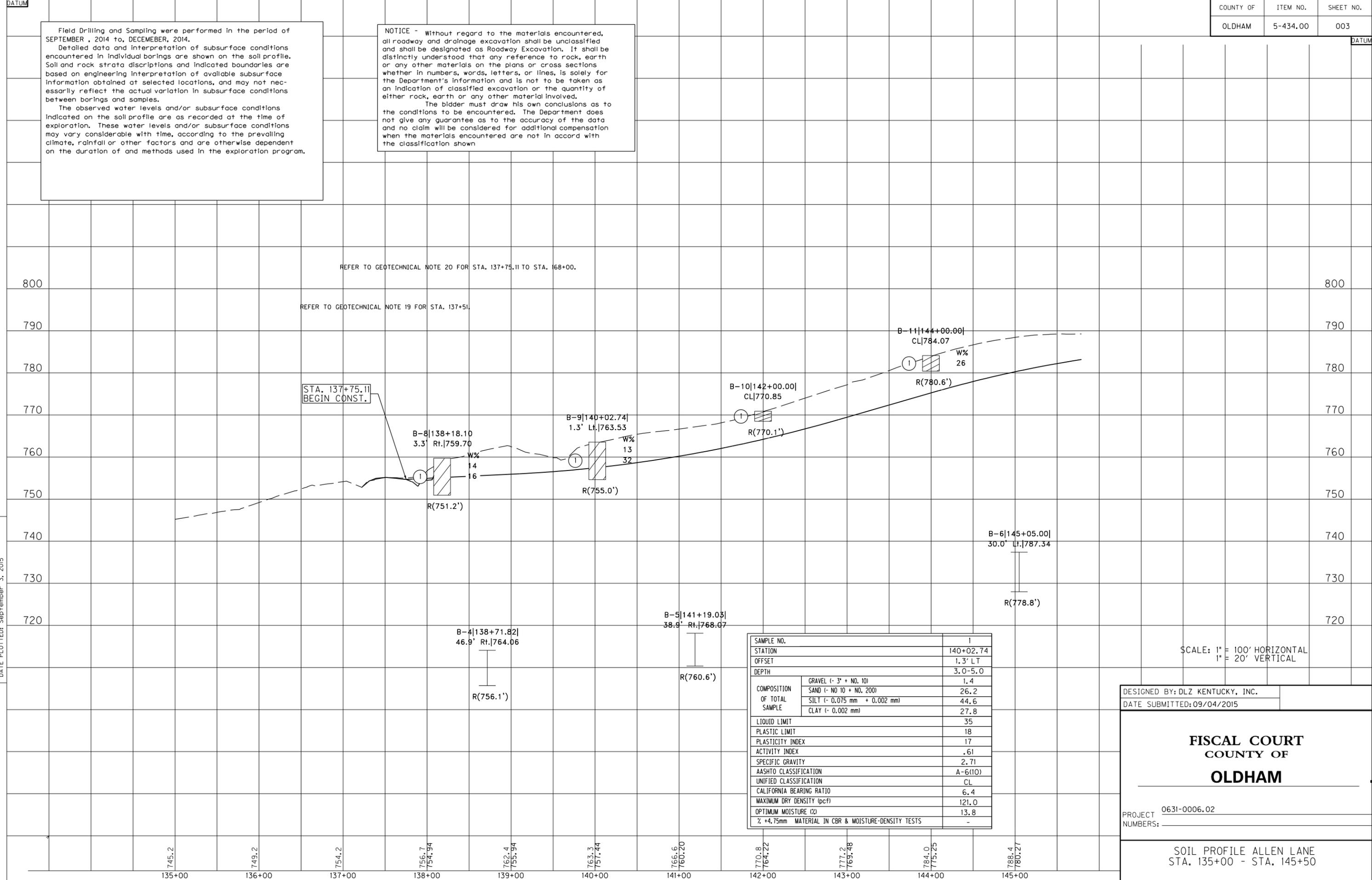
Detailed data and interpretation of subsurface conditions encountered in individual borings are shown on the soil profile. Soil and rock strata descriptions and indicated boundaries are based on engineering interpretation of available subsurface information obtained at selected locations, and may not necessarily reflect the actual variation in subsurface conditions between borings and samples.

The observed water levels and/or subsurface conditions indicated on the soil profile are as recorded at the time of exploration. These water levels and/or subsurface conditions may vary considerable with time, according to the prevailing climate, rainfall or other factors and are otherwise dependent on the duration of and methods used in the exploration program.

NOTICE - Without regard to the materials encountered, all roadway and drainage excavation shall be unclassified and shall be designated as Roadway Excavation. It shall be distinctly understood that any reference to rock, earth or any other materials on the plans or cross sections whether in numbers, words, letters, or lines, is solely for the Department's information and is not to be taken as an indication of classified excavation or the quantity of either rock, earth or any other material involved.

The bidder must draw his own conclusions as to the conditions to be encountered. The Department does not give any guarantee as to the accuracy of the data and no claim will be considered for additional compensation when the materials encountered are not in accord with the classification shown.

FILE NAME: M:\PROJ\0631\0006\02\CADD\SHEETS\ROADWAY\ROAD30A.GT.DGN
 USER: mkennedy
 DATE PLOTTED: September 3, 2015
 MicroStation v8.11.9.357



REFER TO GEOTECHNICAL NOTE 20 FOR STA. 137+75.11 TO STA. 168+00.

REFER TO GEOTECHNICAL NOTE 19 FOR STA. 137+51.

STA. 137+75.11
BEGIN CONST.

SAMPLE NO.		1
STATION		140+02.74
OFFSET		1.3' LT
DEPTH		3.0-5.0
COMPOSITION OF TOTAL SAMPLE	GRAVEL (- 3" + NO. 10)	1.4
	SAND (- NO 10 + NO. 200)	26.2
	SILT (- 0.075 mm + 0.002 mm)	44.6
	CLAY (- 0.002 mm)	27.8
LIQUID LIMIT		35
PLASTIC LIMIT		18
PLASTICITY INDEX		17
ACTIVITY INDEX		.61
SPECIFIC GRAVITY		2.71
AASHTO CLASSIFICATION		A-6(10)
UNIFIED CLASSIFICATION		CL
CALIFORNIA BEARING RATIO		6.4
MAXIMUM DRY DENSITY (pcf)		121.0
OPTIMUM MOISTURE (%)		13.8
% +4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS		-

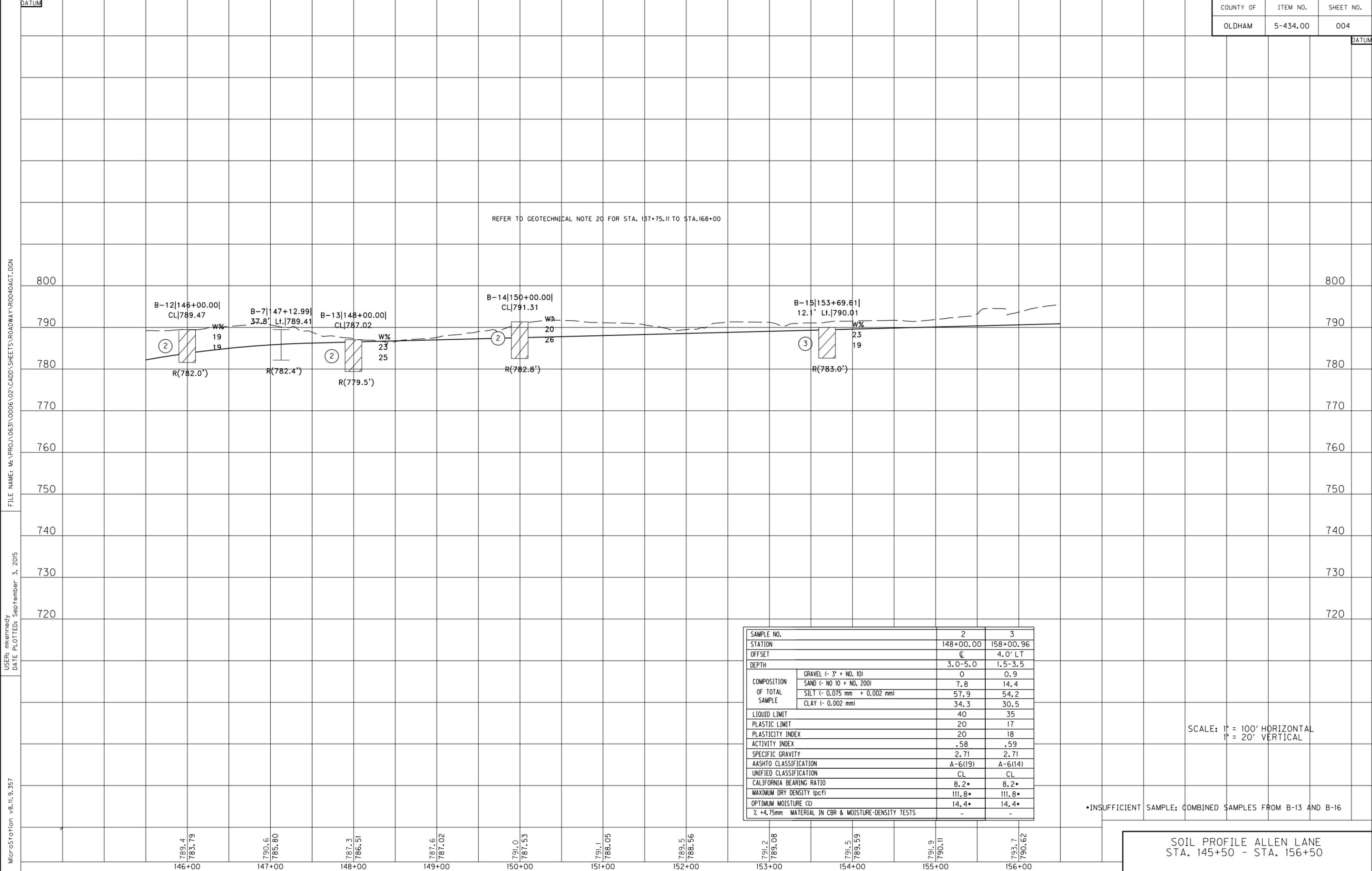
SCALE: 1" = 100' HORIZONTAL
1" = 20' VERTICAL

DESIGNED BY: DLZ KENTUCKY, INC.
DATE SUBMITTED: 09/04/2015

**FISCAL COURT
COUNTY OF
OLDHAM**

PROJECT 0631-0006.02
NUMBERS: _____

SOIL PROFILE ALLEN LANE
STA. 135+00 - STA. 145+00



REFER TO GEOTECHNICAL NOTE 20 FOR STA. 137+75.11 TO STA. 168+00

SAMPLE NO.	2	3
STATION	148+00.00	158+00.96
OFFSET	0	4.0' LT
DEPTH	3.0-5.0	1.5-3.5
COMPOSITION OF TOTAL SAMPLE	GRAVEL (- 3' + NO. 10)	0
	SAND (- NO 10 + NO. 200)	7.8
	SILT (- 0.075 mm + 0.002 mm)	57.9
	CLAY (- 0.002 mm)	34.3
LIQUID LIMIT	40	35
PLASTIC LIMIT	20	17
PLASTICITY INDEX	20	18
ACTIVITY INDEX	.58	.59
SPECIFIC GRAVITY	2.71	2.71
AASHTO CLASSIFICATION	A-6(19)	A-6(14)
UNIFIED CLASSIFICATION	CL	CL
CALIFORNIA BEARING RATIO	8.2*	8.2*
MAXIMUM DRY DENSITY (pcf)	111.8*	111.8*
OPTIMUM MOISTURE (%)	14.4*	14.4*
% +4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS		
	-	-

SCALE: 1" = 100' HORIZONTAL
1" = 20' VERTICAL

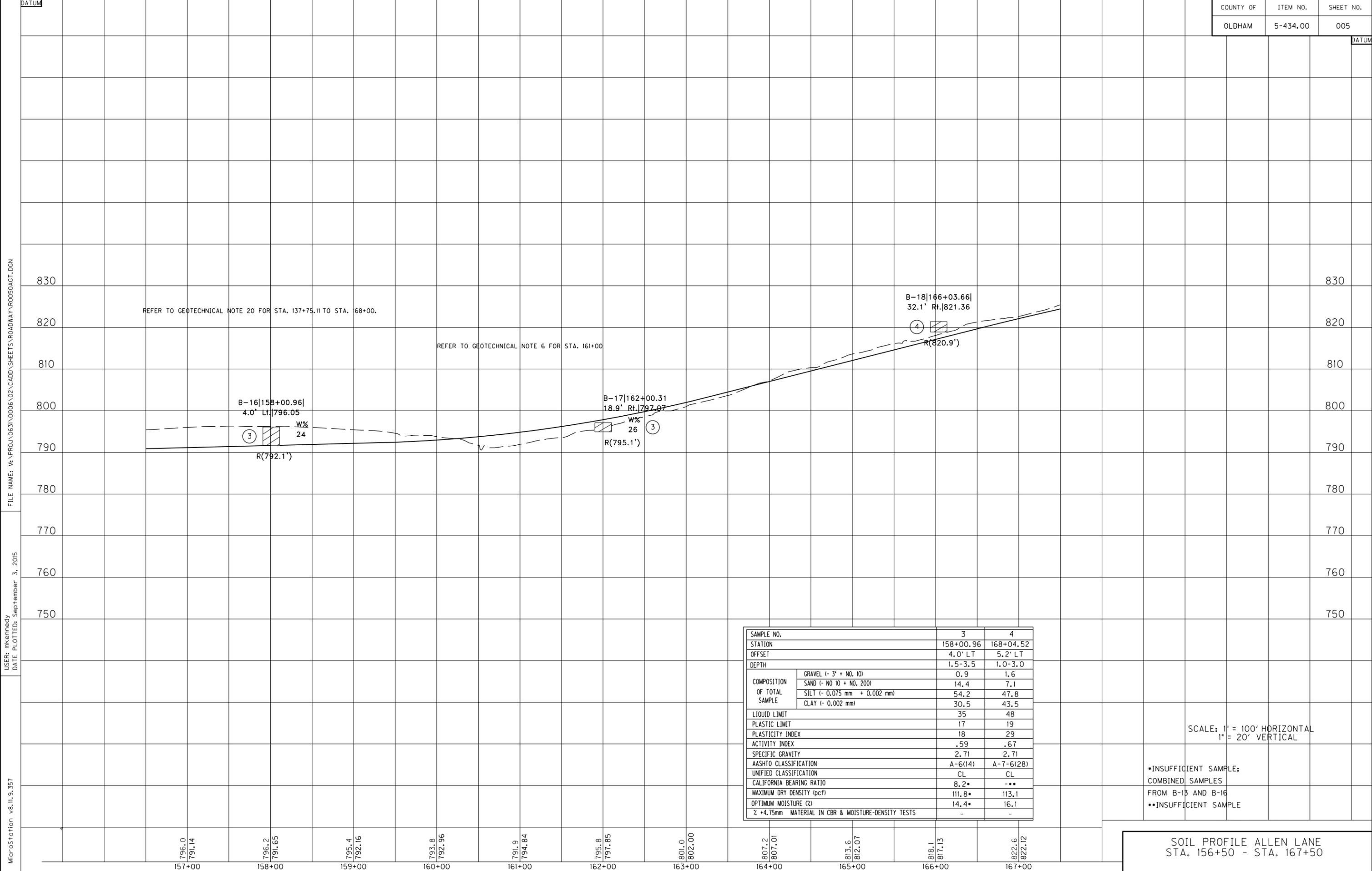
*INSUFFICIENT SAMPLE; COMBINED SAMPLES FROM B-13 AND B-16

SOIL PROFILE ALLEN LANE
STA. 145+50 - STA. 156+50

FILE NAME: M:\PROJ\0631\0006\02\CADD\SHEETS\ROADWAY\ROAD040AGT.DGN

USER: mkennedy
DATE PLOTTED: September 3, 2015

MicroStation v8.11.9.357



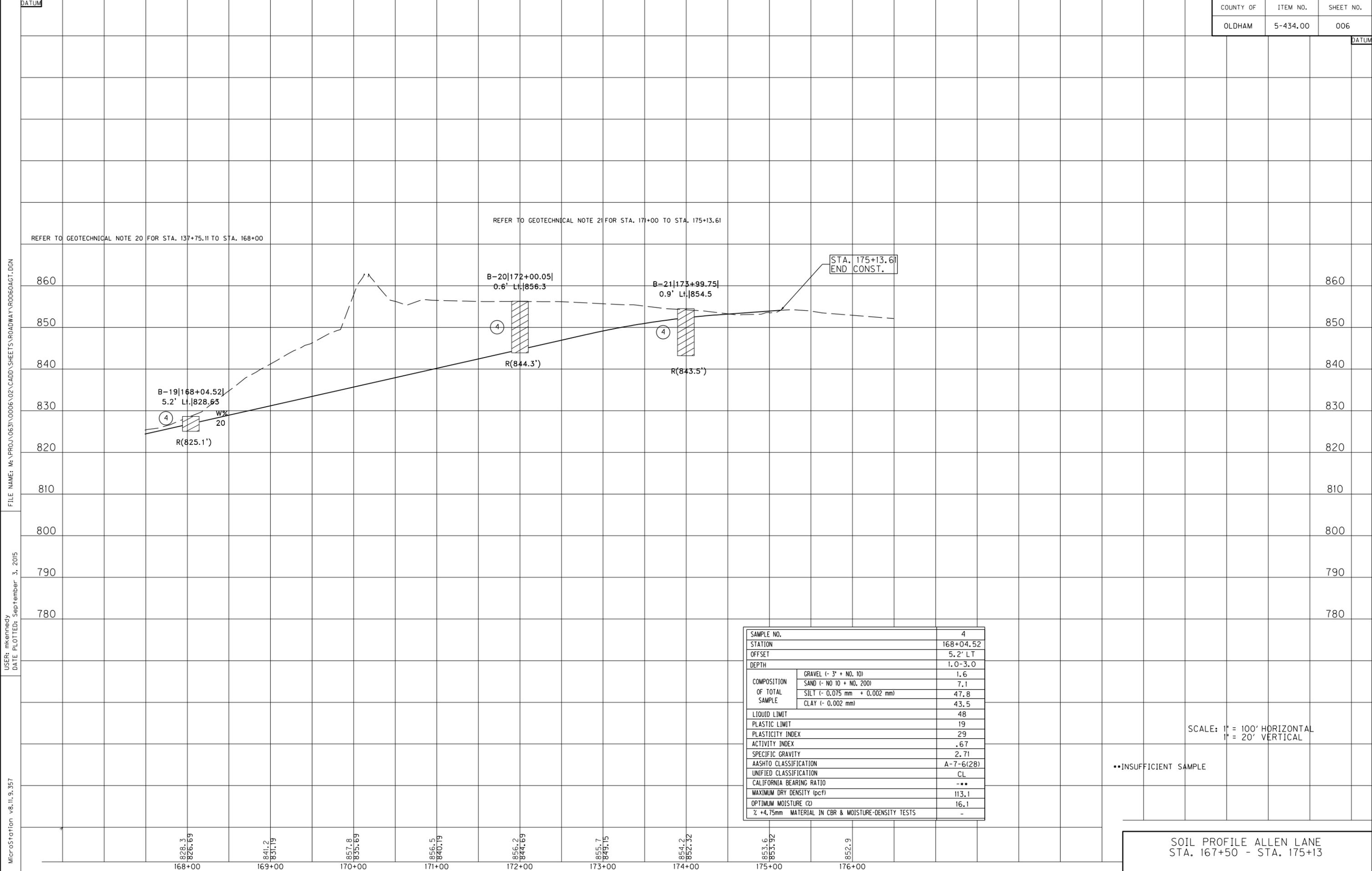
SAMPLE NO.	3	4
STATION	158+00.96	168+04.52
OFFSET	4.0' LT	5.2' LT
DEPTH	1.5-3.5	1.0-3.0
COMPOSITION OF TOTAL SAMPLE	GRAVEL (- 3' + NO. 10)	0.9
	SAND (- NO 10 + NO. 200)	14.4
	SILT (- 0.075 mm + 0.002 mm)	54.2
	CLAY (- 0.002 mm)	30.5
LIQUID LIMIT	35	48
PLASTIC LIMIT	17	19
PLASTICITY INDEX	18	29
ACTIVITY INDEX	.59	.67
SPECIFIC GRAVITY	2.71	2.71
AASHTO CLASSIFICATION	A-6(14)	A-7-6(28)
UNIFIED CLASSIFICATION	CL	CL
CALIFORNIA BEARING RATIO	8.2*	**
MAXIMUM DRY DENSITY (pcf)	111.8*	113.1
OPTIMUM MOISTURE (%)	14.4*	16.1
% +4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS	-	-

SCALE: 1" = 100' HORIZONTAL
1" = 20' VERTICAL

*INSUFFICIENT SAMPLE;
COMBINED SAMPLES
FROM B-13 AND B-16
**INSUFFICIENT SAMPLE

SOIL PROFILE ALLEN LANE
STA. 156+50 - STA. 167+50

FILE NAME: M:\PROJ\0631\006\02\CADD\SHEETS\ROADWAY\0050A01.DGN
 USER: mkennedy
 DATE PLOTTED: September 3, 2015
 MicroStation v8.11.9.357



SAMPLE NO.	4	
STATION	168+04.52	
OFFSET	5.2' LT	
DEPTH	1.0-3.0	
COMPOSITION OF TOTAL SAMPLE	GRAVEL (- 3' + NO. 10)	1.6
	SAND (- NO 10 + NO. 200)	7.1
	SILT (- 0.075 mm + 0.002 mm)	47.8
	CLAY (- 0.002 mm)	43.5
LIQUID LIMIT	48	
PLASTIC LIMIT	19	
PLASTICITY INDEX	29	
ACTIVITY INDEX	.67	
SPECIFIC GRAVITY	2.71	
AASHTO CLASSIFICATION	A-7-6(28)	
UNIFIED CLASSIFICATION	CL	
CALIFORNIA BEARING RATIO	--	
MAXIMUM DRY DENSITY (pcf)	113.1	
OPTIMUM MOISTURE (%)	16.1	
% +4.75mm MATERIAL IN CBR & MOISTURE-DENSITY TESTS	-	

SCALE: 1" = 100' HORIZONTAL
1" = 20' VERTICAL

••INSUFFICIENT SAMPLE

SOIL PROFILE ALLEN LANE
STA. 167+50 - STA. 175+13

FILE NAME: M:\PROJ\0631\006\02\CADD\SHEETS\ROADWAY\RD060A01.DGN

USER: mkennedy
DATE PLOTTED: September 3, 2015

MicroStation v8.11.9.357

DATUM

DATUM

REFER TO GEOTECHNICAL NOTE 20 FOR STA. 137+75.11 TO STA. 168+00

REFER TO GEOTECHNICAL NOTE 20 FOR STA. 171+00 TO STA. 175+13.61

B-19|168+04.52|
5.2' Lt.|828.63
W%
20
R(825.1')

B-20|172+00.05|
0.6' Lt.|856.3
R(844.3')

B-21|173+99.75|
0.9' Lt.|854.5
R(843.5')

STA. 175+13.61
END CONST.

828.3
826.69
168+00

841.2
831.19
169+00

857.8
835.69
170+00

856.5
840.19
171+00

856.2
844.69
172+00

855.7
849.15
173+00

854.2
852.32
174+00

853.6
853.92
175+00

852.9
176+00

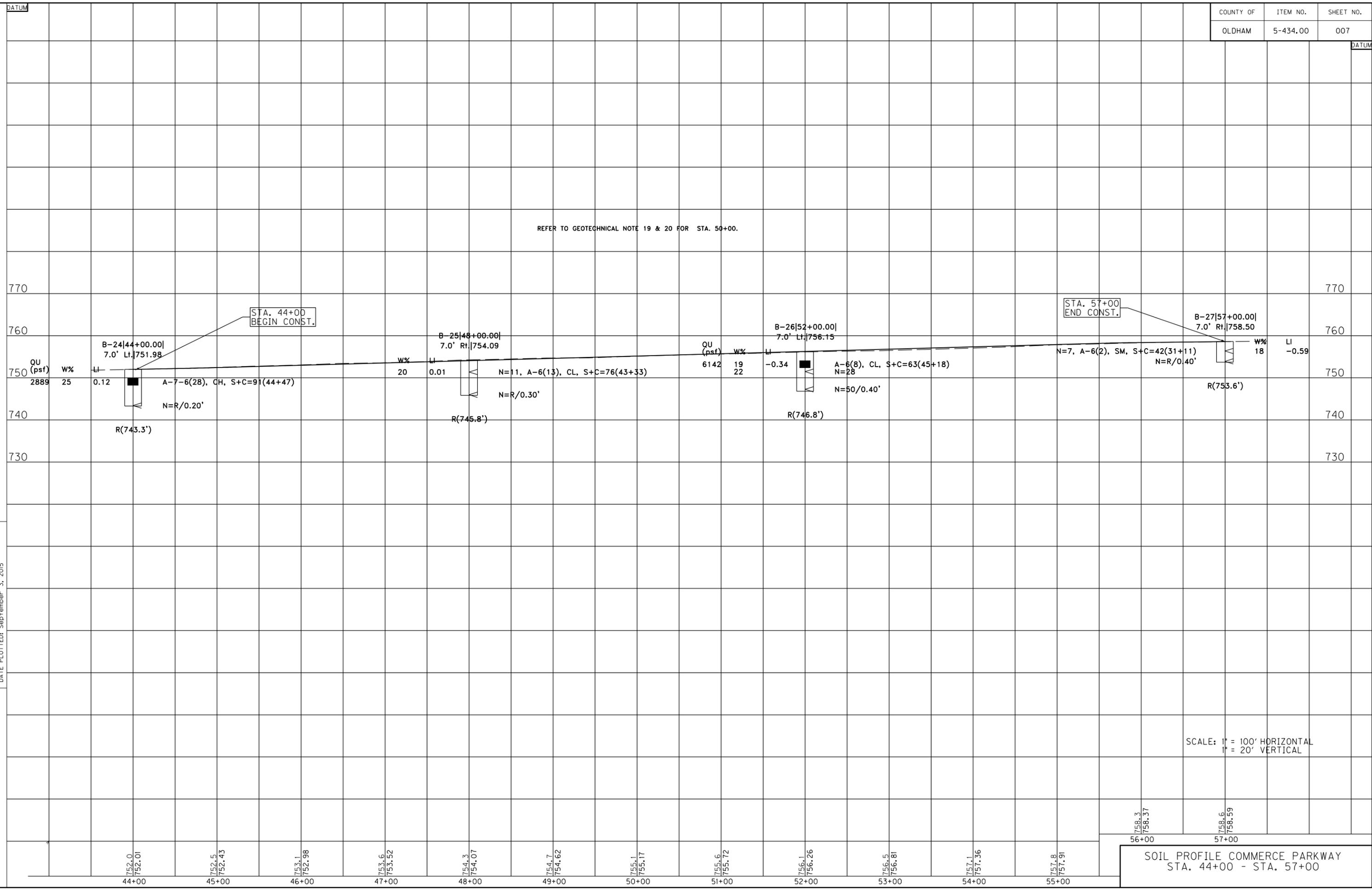
DATUM

REFER TO GEOTECHNICAL NOTE 19 & 20 FOR STA. 50+00.

FILE NAME: M:\PROJ\0631\0006\02\CADD\SHEETS\ROADWAY\ROOT0A.GT.DGN

USER: mkennedy
DATE PLOTTED: September 3, 2015

MicroStation v8.11.9.357



SCALE: 1" = 100' HORIZONTAL
1" = 20' VERTICAL

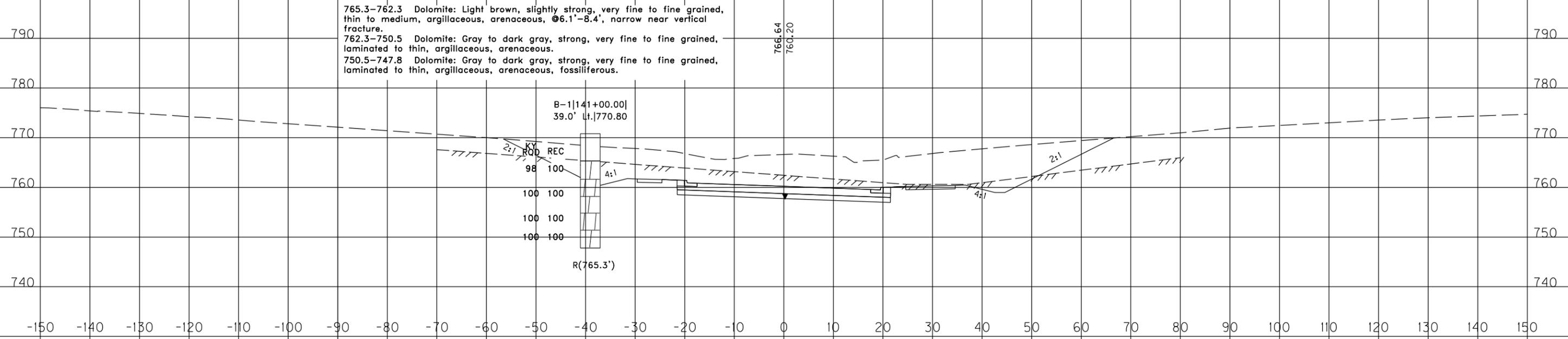
758.3
758.37
56+00
758.6
758.59
57+00

SOIL PROFILE COMMERCE PARKWAY
STA. 44+00 - STA. 57+00

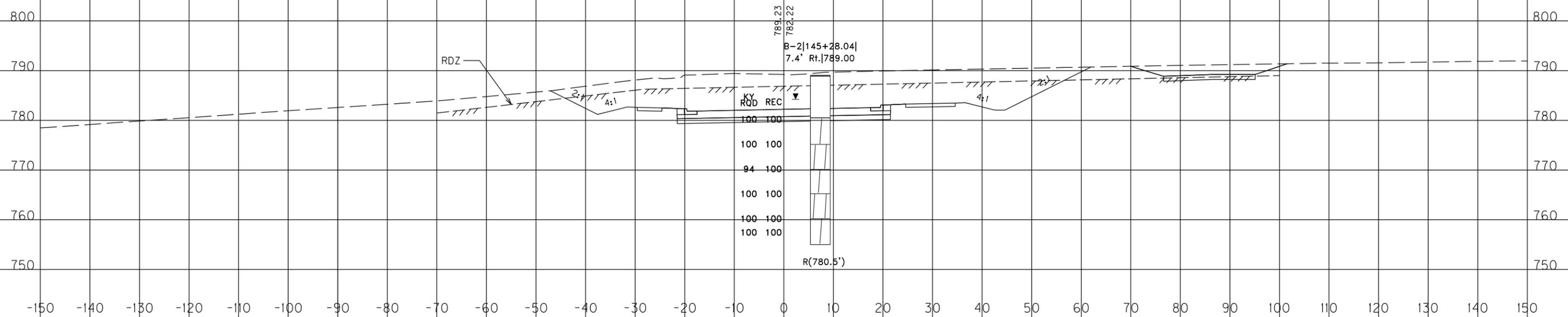
44+00 45+00 46+00 47+00 48+00 49+00 50+00 51+00 52+00 53+00 54+00 55+00

COUNTY OF	ITEM NO.	SHEET NO.
OLDHAM	5-434.00	008

765.3-762.3 Dolomite: Light brown, slightly strong, very fine to fine grained, thin to medium, argillaceous, arenaceous, @6.1'-8.4', narrow near vertical fracture.
 762.3-750.5 Dolomite: Gray to dark gray, strong, very fine to fine grained, laminated to thin, argillaceous, arenaceous.
 750.5-747.8 Dolomite: Gray to dark gray, strong, very fine to fine grained, laminated to thin, argillaceous, arenaceous, fossiliferous.



780.5-779.9 Dolomite: Brown, highly weathered, strong, very fine grained, thinly bedded, stylonite.
 779.9-755.0 Dolomite: Gray, strong, very fine grained, thinly bedded to massive, argillaceous, narrow slightly rough horizontal joints @9.2', 11.7', 16.7', 17.5', narrow slightly rough horizontal clay filled joints @10.4'.



FILE NAME: M:\PROJ\0631\006\02\CADD\SHEETS\ROADWAY\ROADWAGT.DGN

USER: mkennedy
DATE PLOTTED: September 3, 2015

MicroStation v8.11.9.357

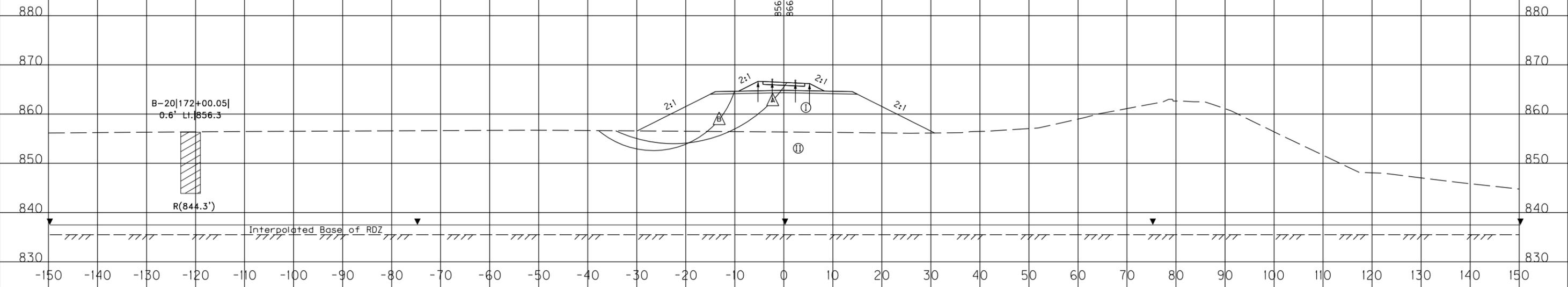
SCALE: 1" = 20'
HORIZONTAL
1" = 20'
VERTICAL

CUT STABILITY SECTIONS
ALLEN LANE STA. 140+00
RAILROAD RUNAROUND STA 1529+50

FILE NAME: M:\PROJ\0631\0006\02\CADD\SHEETS\ROADWAY\RD090A.G1.DGN

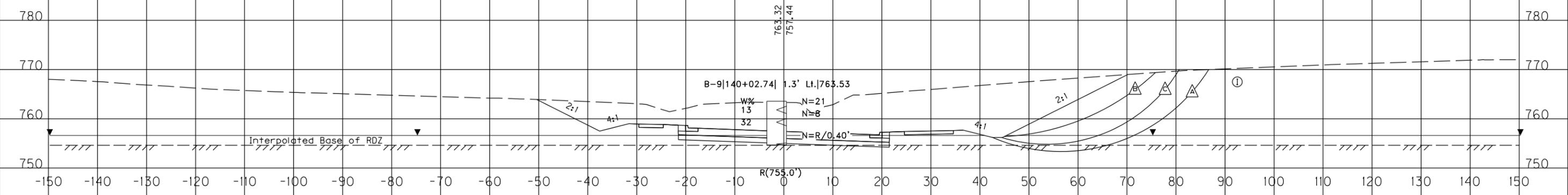
USER: mkennedy
DATE PLOTTED: September 3, 2015

MicroStation v8.11.9.357



1529+50
RAILROAD RUNAROUND

ASSUMED SOIL STRENGTH PARAMETERS			FACTORS OF SAFETY		
SOIL	I	II	SHORT TERM	A	3.0
SHORT TERM	$\phi = 125$ pcf $c = 1,500$ psf $\delta = 0$	$\phi = 130$ pcf $c = 1,000$ psf $\delta = 0$	LONG TERM	B	2.0
LONG TERM	$\phi = 125$ pcf $c = 270$ psf $\delta = 28$	$\phi = 130$ pcf $c = 40$ psf $\delta = 20$			



TYPICAL
ALLEN LANE

ASSUMED SOIL STRENGTH PARAMETERS		FACTORS OF SAFETY		
SOIL	I	SHORT TERM	A	3.5
SHORT TERM	$\phi = 130$ pcf $c = 1,000$ psf $\delta = 0$	INTERMEDIATE TERM	B	1.8
INTERMEDIATE TERM	$\phi = 130$ pcf $c = 200$ psf $\delta = 26$	LONG TERM	C	1.4
LONG TERM	$\phi = 130$ pcf $c = 40$ psf $\delta = 26$			

SCALE: 1" = 20' HORIZONTAL
1" = 20' VERTICAL

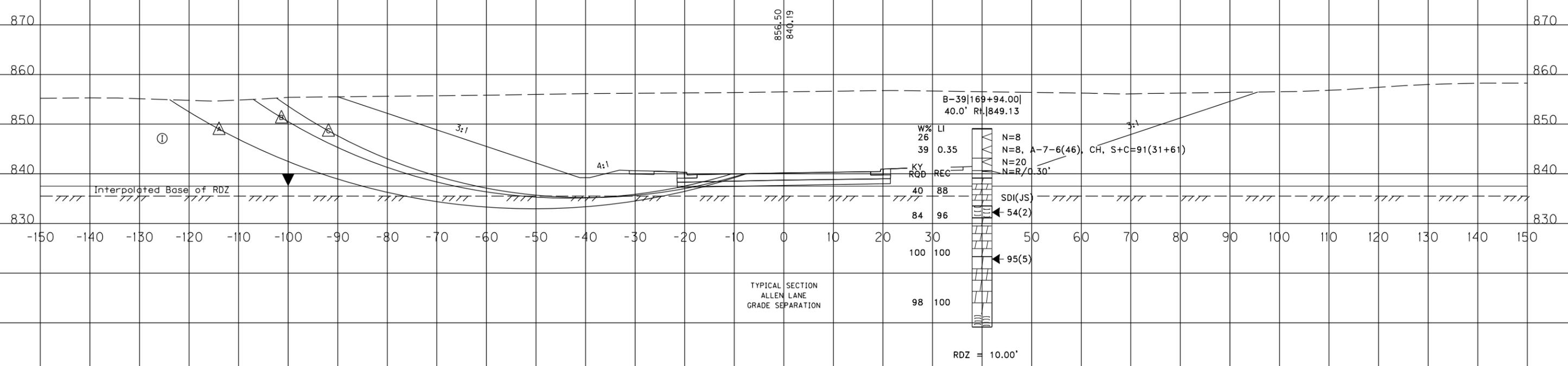
CUT STABILITY SECTIONS
ALLEN LANE STA. 140+00
RAILROAD RUNAROUND STA 1529+50

ASSUMED SOIL STRENGTH PARAMETERS	
SOIL	I
SHORT TERM	$\phi = 130$ pcf $c = 1,000$ psf $\delta = 0$
INTERMEDIATE TERM	$\phi = 130$ pcf $c = 200$ psf $\delta = 20$
LONG TERM	$\phi = 130$ pcf $c = 40$ psf $\delta = 20$

FACTORS OF SAFETY		
SHORT TERM	A	3.0
INTERMEDIATE TERM	B	2.1
LONG TERM	C	1.4

Cut Limits from Sta. 171+00 to Sta. 175+13.61

No. B-39
 Log Sta. 169+94.00 40.0' rt
 849.1-839.1 Overburden
 839.1-835.2 Dolomite: Brown, strong, fine to coarse grained, very thinly to thinly bedded, argillaceous, vuggy
 835.2-833.5 Dolomite: Gray, strong, thinly to thickly bedded, argillaceous
 833.5-831.1 Shale: Gray, moderately strong, thinly laminated, calcareous
 831.1-823.3 Dolomite: Gray, strong, thinly to thickly bedded, argillaceous
 823.3-809.1 Shale: Gray, moderately strong, thinly laminated, calcareous



TYPICAL SECTION
 ALLEN LANE
 GRADE SEPARATION

RDZ = 10.00'

SCALE: 1" = 20'
 1" = 20'

HORIZONTAL
 VERTICAL

CUT STABILITY SECTION
 ALLEN LANE GRADE SEPARATION
 STA. 171+00

FILE NAME: M:\PROJ\0631\0006\02\CADD\SHEETS\ROADWAY\RD00A0GT.DGN

USER: mkenedy
 DATE PLOTTED: September 3, 2015

MicroStation v8.11.9.357