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APPROVED
Engineering Department
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EPC Planning & Community Development Department

GEOTECHNICAL ENGINEERING STUDY
PROPOSED TURN LANE
LIBERTY TREE ACADEMY
EASTONVILLE ROAD AND SNAFFLE BIT ROAD
PEYTON, COLORADO

Prepared By:
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45969
JULY 13, 2021

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PCD File No. PPR-2018
Project No. 21-2-184

July 9, 2021
Revised July 13, 2021

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SUMMARY

1. Three borings were drilled for this study. In general, the soils encountered consisted of about 2½ to 4½ feet of fill overlying native soils extending to the maximum explored depth of 10 feet. The fill consisted of silty to clayey sand, and was underlain by relatively clean native sand.

   Water was measured at a depth of 9.5 feet at Boring 3, but was not encountered elsewhere. Drilling was conducted shortly after a significant precipitation event, and the water measured may not reflect long-term groundwater levels. The depth to groundwater is anticipated to fluctuate over time but groundwater is unlikely to be a construction consideration for this project. Surface water will require adequate drainage to prevent damage to the subgrade soils both during and after construction.

2. Fill with unknown placement conditions was encountered at this site extending to depths of up to 4½ feet below the existing grade. To provide a stable bearing surface and to mitigate the risk of future distress, we recommend that the existing fill be removed in its entirety. However, due to the proximity to the existing adjacent roadway, the complete removal of this fill would be impractical, and may result in the loss of support of the existing pavement. If the client/owner accepts a somewhat greater risk of future distress, partial removal of the existing fill may be considered. If the roadway is properly constructed, we estimate this risk will still be relatively low.

3. We understand that Eastonville road is classified as a rural principal arterial (4-lane) as presented in the El Paso County Pavement Design Criteria Manual (ECM). The default traffic value for this roadway type presented in table D-2 of the ECM is 2,628,000 18-kip ESAL's over the design life of the pavement. Based on this volume, the directional ESAL value was determined to be ½ this value, or 1,314,000. Table D-1 indicates that a lane distribution factor of 0.9 should be used for this class of roadway, but in consideration of the fact that the proposed lane will be in addition to the two existing, will not be part of the mainline traffic pattern, and will only service the school, a reduced factor of 0.6 was used to estimate the design ESAL value. Using this factor, a value of 788,400 was determined for our design. If it is determined that actual traffic volume or roadway designation is significantly different from the estimated values, we should be contacted to reevaluate the pavement thickness design presented in this report.

4. Based on the assumed traffic volume, a composite pavement section consisting of 6 inches of Hot Mix Asphalt (HMA) overlying 8 inches of Class 6 Aggregate Base Course (ABC) was determined. This section meets or exceeds the minimum pavement section presented in Table D-2 of the ECM. Per El Paso County requirements, a full depth HMA section (non-composite) may not be considered for use.

PURPOSE AND SCOPE OF STUDY

This report presents the results of a geotechnical engineering study for the construction of a new righthand turn lane on Eastonville Road in Peyton, Colorado. The overall project site is shown on Fig. 1. The study was conducted in general accordance with the scope of work in our Proposal No. C21-275, dated Jue 15, 2021, for the purpose of providing pavement section thickness recommendations.

This report has been prepared to summarize the data obtained during this study and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to the proposed construction are included in the report.

PROPOSED CONSTRUCTION

We understand that the proposed construction will consist of a new righthand turn lane beginning at Motley Road and extending to Snaffle Bit Road for a total length of about 450 lineal feet. The lane will provide access to the proposed north parking area at the Liberty Tree Academy. The final grade will match that of the adjacent roadway surface. If the proposed construction is significantly different from that described above or depicted in this report, we should be notified to reevaluate the recommendations contained in this report.

SITE CONDITIONS

The project site is located on the southeast side of Eastonville Road just north of the Liberty Tree Academy. The region is relatively flat, with a slight downward slope to the south. At the time of our site visit, the area had already been excavated to a depth of about one foot below the base of the existing pavement, which appeared to have been constructed as a full depth asphalt section about 6½ inches thick. The south portion of the excavation (about 150 feet) contained standing water due to the recent precipitation event. The water was several inches deep in some areas.

Eastonville Road appears to consist of older pavement, and contains regularly-spaced lateral cracks that appear to be the result of thermal shrinkage as well as other lateral cracks, and also has some patching in areas that are likely to have poor subgrade support. Longitudinal cracks are also present, and appear to be located at the pavement seams.

FIELD EXPLORATION AND SUBSURFACE CONDITIONS

The exploratory borings were drilled at the approximate locations shown on Fig. 1 using a 4-inch diameter continuous-flight solid stem auger powered by a truck mounted drill rig.

In general, the soils encountered consisted of about 2½ to 4½ feet of fill overlying native soils extending to the maximum explored depth of 10 feet. The fill consisted of silty to clayey sand, was coarse grained, moist to wet, and mottled brown in appearance. The underlying native silty and poorly graded sand with silt was fine to coarse grained with varied amounts of gravel, loose to medium dense, moist to very moist, and brown in color.

Water was measured at a depth of 9.5 feet at Boring 3, but was not encountered elsewhere. Drilling was conducted shortly after a significant precipitation event, and the water measured may not reflect long-term groundwater levels. The depth to groundwater is anticipated to fluctuate over time but groundwater is unlikely to be a construction consideration for this project. Surface water will require adequate drainage to prevent damage to the subgrade soils both during and after construction.

Laboratory testing performed on selected samples obtained from the borings included the natural moisture content and dry density, gradation analysis, liquid and plastic limits, Hveem's stability testing (R-value), and water-soluble sulfate concentrations. The laboratory test results are shown adjacent to the boring logs on Fig. 2, plotted graphically on Figs. 3 through 6, and summarized in Table I.

GEOTECHNICAL CONSIDERATIONS

Fill with unknown placement conditions was encountered at this site extending to depths of up to 4½ feet below the existing grade. To provide a stable bearing surface and to mitigate the risk of future distress, we recommend that the existing fill be removed in its entirety. However, due to the proximity to the existing adjacent roadway, the complete removal of this fill would be impractical, and may result in the loss of support of the existing pavement. If the client/owner accepts a somewhat greater risk of future distress, partial removal of the existing fill may be considered. If the roadway is properly constructed, we estimate this risk will still be relatively low.

If the partial removal of existing fill is considered, we recommend the scarification, moisture conditioning, and re-compaction of the existing soils to a depth of at least 12 inches below the existing grade. The re-compacted soils should then be proof rolled with a heavy vehicle in order to determine if any unstable areas are present. Recommendations for the treatment of these areas are presented in this report. After proof rolling and stabilization where necessary, additional subgrade material may be placed to bring the elevation up to the base of the pavement section.

PAVEMENT DESIGN

A pavement section is a layered system designed to distribute concentrated traffic loads to the subgrade. Performance of the pavement structure is directly related to the physical properties of the subgrade soils, pavement section, and traffic loadings. The number and magnitude of wheel loads are major factors for pavement design.

Subgrade Materials: Based on the American Association of State Highway Transportation Officials (AASHTO) classification system the soils tested near the proposed subgrade elevation were generally A-2-4 soils with a group index of 0. In general, these soil types are considered good for use as subgrade materials.

The Hveem's stabilometer test results (R-value) presented on Fig. 6 indicates an R-value of 30 for the composite sample of A-2-4 soil tested. An R-value of 20 was selected for design purposes based on the results of the laboratory testing and our experience with similar soils. Based on the AASHTO 1993 design method presented in the El Paso County Pavement Design Criteria Manual (ECM), this value corresponds to a resilient modulus of 4,940 psi for the design of flexible pavement. If imported fill is used, tests should be performed to ensure it meets or exceeds the design R-value.

Design Traffic: We understand that Eastonville road is classified as a rural principal arterial (4-lane) as presented in the El Paso County Pavement Design Criteria Manual (ECM). The default traffic value for this roadway type presented in table D-2 of the ECM is 2,628,000 18-kip ESAL's over the design life of the pavement. Based on this volume, the directional ESAL value was determined to be ½ this value, or 1,314,000. Table D-1 indicates that a lane distribution factor of 0.9 should be used for this class of roadway, but in consideration of the fact that the proposed lane will be in addition to the two existing, will not be part of the mainline traffic pattern, and will only service the school, a reduced factor of 0.6 was used to estimate the design ESAL value. Using this factor, a value of 788,400 was determined for our design. If it is determined that actual traffic volume or roadway designation is significantly different from the estimated values, we should be contacted to reevaluate the pavement thickness design presented in this report.

Pavement Sections: The recommended sections were determined using the AASHTO 1993 design method as outlined in the ECM. The parameters presented in the table below were used for design purposes.

Parameter	Design Value
Roadway Type	Rural Principal Arterial, 4-lane
Design Serviceability Loss	2.5
Reliability	85 percent
Asphalt Strength Coefficient	0.44
ABC Strength Coefficient	0.11
Overall Standard Deviation	0.45

Based on the assumed traffic volume, a composite pavement section consisting of 6 inches of Hot Mix Asphalt (HMA) overlying 8 inches of Class 6 Aggregate Base Course (ABC) was determined. This section meets or exceeds the minimum pavement section presented in Table D-2 of the ECM. Per El Paso County requirements, a full depth HMA section (non-composite) may not be considered for use.

Pavement Materials: The asphalt pavement should consist of a bituminous material which meets the requirements of the Pikes Peak Region Asphalt Paving Specifications. Aggregate base course should meet the requirements of a CDOT Class 6 and those requirements presented in the ECM. Based on the anticipated traffic volume, a Superpave SX mix with a design gyration N value of 75, and a binder performance grade of 64-28 should be used. A PG 58-28 binder may also be considered, but may be somewhat more susceptible to rutting. A minimum lift thickness of 2-inches is recommended. Lift thickness should not exceed 3 inches unless pneumatic or vibratory rollers are used.

Subgrade Preparation: As specified in the "Site Grading" section, ground surfaces should be scarified to a depth of 12 inches, moisture conditioned, and compacted prior to placement of new fill. After compaction, a proof roll should be conducted to identify unstable areas, which should be repaired according to the recommendations presented in the "Subgrade Stabilization" subsection presented below. New fill should then be moisture conditioned and recompacted in accordance with the "Site Grading and Earthwork" section of this report.

To develop a properly compacted, stable surface with sufficient moisture content, we recommend that immediately prior to paving, the pavement subgrade be thoroughly scarified and well-mixed to a minimum depth of 12 inches and adjusted to the moisture and compaction criteria presented in the "Site Grading and Earthwork" section of the report. This should occur no more than 48 hours before the placement of pavement materials.

Proof Roll: Before paving, the subgrade should be proof rolled with a heavily loaded, pneumatic-tired vehicle. The vehicle should have a gross weight of at least 50,000 pounds, with a single loaded axle weight of 18,000 pounds, and a tire pressure of 100 psi. Areas that deform excessively under heavy wheel loads are not stable, and should be removed and replaced with suitable material to achieve a stable subgrade prior to paving.

Maintenance: The periodic maintenance of paved areas is critical to achieve the desired pavement life. Preventative measures such as crack sealing, the application of chip seals, fog seals, or slurry seals, patching and structural overlays should be applied when necessary.

Subgrade Stabilization: Given the conditions encountered, it should be anticipated that some unstable subgrade areas will be encountered during construction. We anticipate that a portion of the roadway will have soils with moisture contents above the optimum. Subgrade soils with elevated moisture contents are expected to be unstable and prone to deflections and rutting.

We anticipate stabilization of these areas may be achieved by methods such as scarification of the subgrade to accelerate partial drying of the materials; excavation and replacement of unstable soils with drier materials; or stabilization using geogrid reinforcement (Type 2 Geogrid or similar) in combination with 1 to 2 feet of aggregate base course. Specific stabilization requirements should be evaluated at the time of construction. Given the amount of subsurface information collected, we cannot predict or quantify areas where unstable subgrade conditions may occur. However, we recommend this work activity, if required, be included as a line item in the bid schedule to avoid cost overruns.

Drainage: Providing proper surface drainage, both during construction and after the construction has been completed, is very important for acceptable performance of this project. Drainage considerations should ensure that excessive wetting or drying of the pavement subgrades is avoided during construction. Additionally, drainage design should provide for the removal of water from paved areas and prevent the wetting of the subgrade soils.

It is possible for irrigation and other surface water runoff to flow from behind the curb or sidewalk, and to wet the underlying subgrade soils. If surface drainage and landscape irrigation design cannot avoid this condition, interceptor underdrains should be considered. The drains should be located directly below the curb and gutter to a depth of at least 2 feet below the pavement elevation. The underdrains should have a minimum slope of 1% along the drain alignment and sufficient lateral outlets to divert the collected water to suitable discharge points. Drains should consist of perforated pipe surrounded by free-draining gravel wrapped with a geotextile. The gravel should extend to the curb subgrade level.

SITE GRADING AND EARTHWORK

We recommend the following criteria be used when preparing the site grading plans.

Fill Material Specifications: The following material specifications are presented for fills on the project site.

Fill Below Pavements: The on-site soils, minus any deleterious materials, will be generally be suitable for reuse. Import soils if used, should consist of a non-expansive soil, consisting of a minus 2-inch material that has a maximum 50% passing the No. 200 sieve, a maximum plasticity index of 15, and an R-value of at least 20.

Material Suitability: All fill material should be free of vegetation, brush, sod and other deleterious substances. The geotechnical engineer should evaluate the suitability of all proposed fill materials prior to placement.

Subgrade Preparation: The ground surface shall be stripped of vegetation/organics, loose soils, or any other unsuitable materials prior to fill placement. The resulting ground surface should be scarified to a depth of 12 inches; moisture conditioned as necessary, and compacted in a manner specified below for the subsequent layers of fill. As noted within this report, the compacted surface should be proof rolled prior to the placement of additional fill.

Compaction Requirements: A representative of the geotechnical engineer should observe fill placement operations on a full-time basis. We recommend the following minimum compaction criteria be used on the project.

Area	Percentage of Standard Proctor Maximum Dry Density (ASTM D 698)
Aggregate Base Course (ABC)	100%*
Pavement Subgrade	95%
Exterior Flatwork, Fill placed for Site Grading	95%
Landscape and Other Misc. Overlot Fill Areas	95%
Compaction of fill materials should be achieved at a moisture content within +0 to +3 percent for cohesive materials, and within 2 percent of optimum for granular soils. *: ABC may be compacted to 95% of the **modified proctor density (ASTM D1557)** at a moisture content near optimum**.**	

New fill should be placed in horizontal layers not to exceed 8 inches in loose lift thickness. Each layer should be compacted prior to the placement of subsequent layers. Spreading equipment should be used to obtain uniform thickness prior to compaction. As the compaction progresses, continuous mixing, leveling, and manipulating shall be done to assure uniform moisture and density.

EXCAVATION CONSIDERATIONS

In our opinion, excavation of the overburden soils should be possible with conventional excavation equipment.

All excavations should be in accordance with OSHA, state and local requirements. The contractor should follow appropriate safety precautions. In accordance with OSHA guidelines, the native soils will likely classify as a Type C material. A contractor's competent person should make decisions regarding soil types encountered during excavation.

Per OSHA criteria, unless excavations are shored, temporary unretained excavations in Type C materials should have slopes no steeper than 1½:1 (H: V). Flatter slopes will be required where ground-water is encountered. Surface draining should be diverted away from all temporary cut slopes in order to reduce the potential for slope erosion and instability. OSHA regulations require that excavations greater than 20 feet in depth be designed by a professional engineer.

If groundwater is encountered in excavations, we believe the dewatering can be accomplished by pumping from sumps installed within the excavation. The pits should be constructed well below the base of the excavation to avoid loss of supporting capacity of the soils. The dewatering system should be properly designed, installed and maintained. The bottom and sides of the excavation may become unstable if the groundwater level is not maintained at a sufficient depth below the bottom of the excavation. Overly moist soils may also contribute to unstable subgrade conditions when preparing roadway embankment.

WATER SOLUBLE SULFATES

The concentration of water soluble sulfates measured in a representative sample obtained from the exploratory borings was 0.15 percent. This concentration of water soluble sulfates represents a Class 1 severity of exposure to sulfate attack on concrete exposed to these materials. The degree of attack is based on a range of Class 0 to Class 3 severity of exposure as presented in ACI 201. Based on the laboratory data and our experience, we recommend all concrete exposed to the on-site materials meet the cement requirements for Class 1 exposure as presented in ACI 201. Alternatively, the concrete could meet the Colorado Department of Transportation's (CDOT) cement requirements for Class 1 exposure as presented in Section 601.04 of the CDOT Standard Specifications for Road and Bridge Construction.

DESIGN AND CONSTRUCTION SUPPORT SERVICES

Kumar & Associates, Inc. should be retained to review the project plans and specifications for conformance with the recommendations provided in our report. We are also available to assist the design team in preparing specifications for geotechnical aspects of the project, and performing additional studies if necessary to accommodate possible changes in the proposed construction.

We recommend that Kumar & Associates, Inc. be retained to provide observation and testing services to document that the intent of this report and the requirements of the plans and specifications are being followed during construction, and to identify possible variations in subsurface conditions from those encountered in this study so that we can re-evaluate our recommendations, if needed.

LIMITATIONS

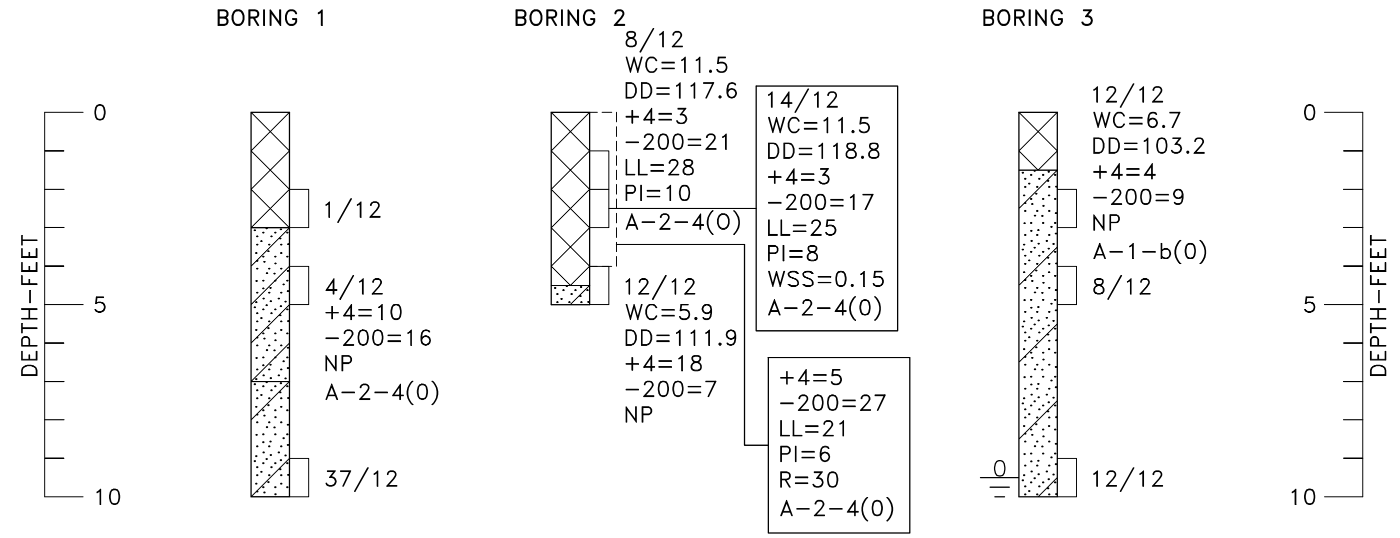
This study has been conducted for exclusive use by the client for geotechnical related design and construction criteria for the project. The conclusions and recommendations submitted in this report are based upon the data obtained from the exploratory borings at the locations indicated on Fig. 1 or as described in the report, and the proposed type of construction. This report may not reflect subsurface variations that occur between the exploratory borings, and the nature and extent of variations across the site may not become evident until site grading and excavations are performed. If during construction, fill, soil, rock or water conditions appear to be different from those described herein, Kumar & Associates, Inc. should be advised at once so that a re-evaluation of the recommendations presented in this report can be made. Kumar & Associates, Inc. is not responsible for liability associated with interpretation of subsurface data by others.

AK/bj

50 0 50 100

APPROXIMATE SCALE–FEET

21–2–184	Kumar & Associates	LOCATION OF EXPLORATORY BORINGS	Fig. 1



LEGEND

FILL: SILTY TO CLAYEY SAND (SM TO SC), FINE TO COARSE GRAINED, MOIST TO WET, MOTTLED BROWNS.

SILTY SAND (SM), FINE TO COARSE GRAINED WITH SOME FINE GRAVEL, LOOSE, MOIST, BROWN.

POORLY GRADED SAND WITH SILT AND VARIED AMOUNTS OF GRAVEL (SP−SM), FINE TO COARSE GRAINED, LOOSE TO MEDIUM DENSE, MOIST TO VERY MOIST, BROWN.

DRIVE SAMPLE, 2−INCH I.D. CALIFORNIA LINER SAMPLE.

1/12 DRIVE SAMPLE BLOW COUNT. INDICATES THAT 1 BLOWS OF A 140−POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE THE SAMPLER 12 INCHES.

NOTES

1. THE EXPLORATORY BORINGS WERE DRILLED ON JUNE 25, 2021 WITH A 4−INCH−DIAMETER CONTINUOUS−FLIGHT POWER AUGER.

2. THE LOCATIONS OF THE EXPLORATORY BORINGS WERE MEASURED APPROXIMATELY BY PACING FROM FEATURES SHOWN ON THE SITE PLAN PROVIDED.

3. THE ELEVATIONS OF THE EXPLORATORY BORINGS WERE NOT MEASURED AND THE LOGS OF THE EXPLORATORY BORINGS ARE PLOTTED TO DEPTH.

4. THE EXPLORATORY BORING LOCATIONS SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.

5. THE LINES BETWEEN MATERIALS SHOWN ON THE EXPLORATORY BORING LOGS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES AND THE TRANSITIONS MAY BE GRADUAL.

6. GROUNDWATER LEVELS SHOWN ON THE LOGS WERE MEASURED AT THE TIME AND UNDER CONDITIONS INDICATED. FLUCTUATIONS IN THE WATER LEVEL MAY OCCUR WITH TIME.

7. LABORATORY TEST RESULTS:
   WC = WATER CONTENT (%) (ASTM D2216);
   DD = DRY DENSITY (pcf) (ASTM D2216);
   +4 = PERCENTAGE RETAINED ON NO. 4 SIEVE (ASTM D6913);
   −200= PERCENTAGE PASSING NO. 200 SIEVE (ASTM D1140);
   LL = LIQUID LIMIT (ASTM D4318);
   PI = PLASTICITY INDEX (ASTM D4318);
   R = HVEEM R−VALUE (AT 300 psi) (ASTM D2844);
   NP = NON−PLASTIC (ASTM D4318);
   WSS = WATER SOLUBLE SULFATES (%) (CP−L 2103);
   A−2−4 (0) = AASHTO CLASSIFICATION (GROUP INDEX) (AASHTO M 145);

21−2−184	Kumar & Associates	LOG OF EXPLORATORY BORINGS	Fig. 2

LEGEND

FILL: SILTY TO CLAYEY SAND (SM TO SC), FINE TO COARSE GRAINED, MOIST TO WET, MOTTLED BROWNS.

SILTY SAND (SM), FINE TO COARSE GRAINED WITH SOME FINE GRAVEL, LOOSE, MOIST, BROWN.

POORLY GRADED SAND WITH SILT AND VARIED AMOUNTS OF GRAVEL (SP-SM), FINE TO COARSE GRAINED, LOOSE TO MEDIUM DENSE, MOIST TO VERY MOIST, BROWN.

DRIVE SAMPLE, 2-INCH I.D. CALIFORNIA LINER SAMPLE.

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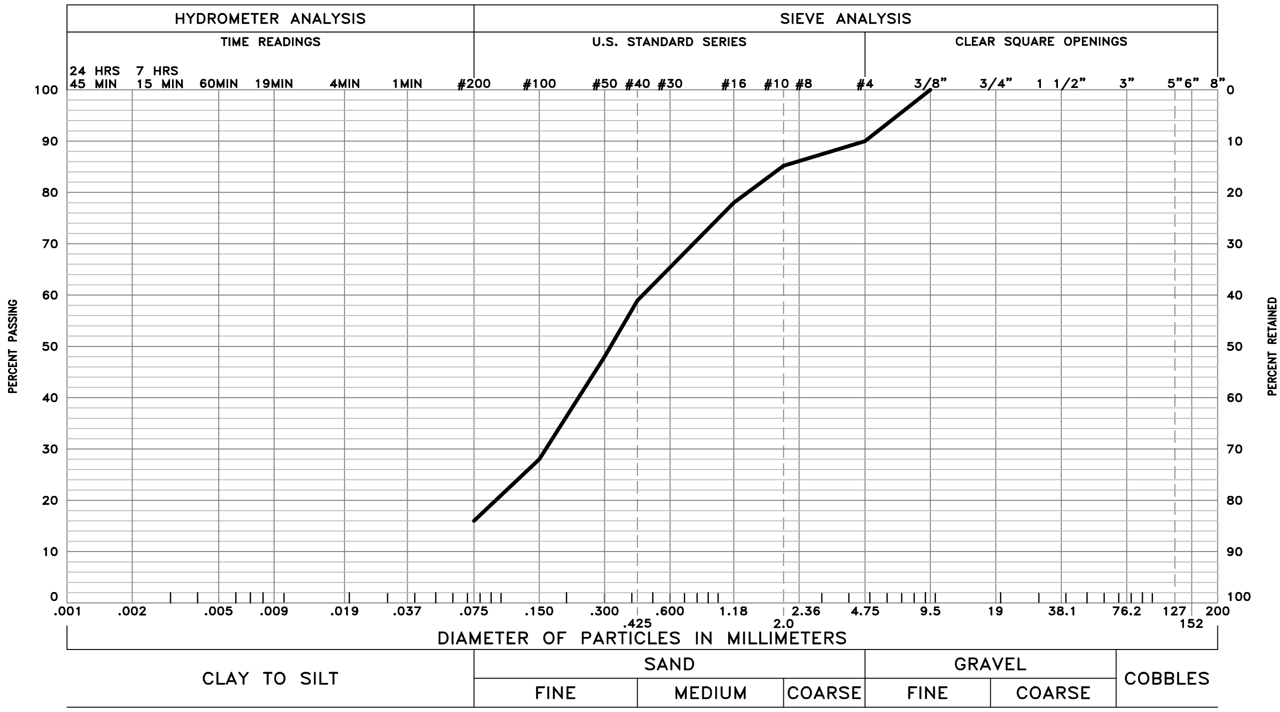
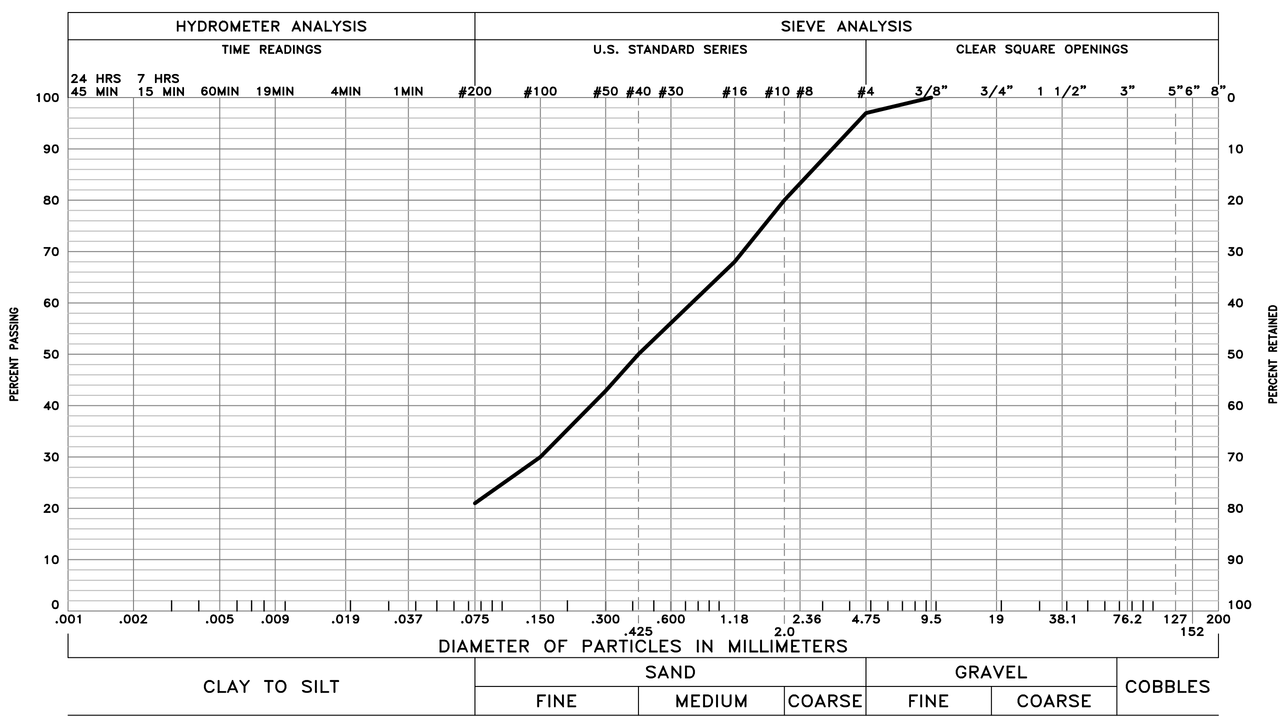
   LL = LIQUID LIMIT (ASTM D4318);
   PI = PLASTICITY INDEX (ASTM D4318);
   R = HVEEM R-VALUE (AT 300 psi) (ASTM D2844);
   NP = NON-PLASTIC (ASTM D4318);
   WSS = WATER SOLUBLE SULFATES (%) (CP-L 2103);
   A-2-4 (0) = AASHTO CLASSIFICATION (GROUP INDEX) (AASHTO M 145).



GRAVEL 10 % SAND 74 % SILT AND CLAY 16 %

LIQUID LIMIT NV PLASTICITY INDEX NP

SAMPLE OF: Silty Sand (SM) FROM: Boring 1 @ 4'



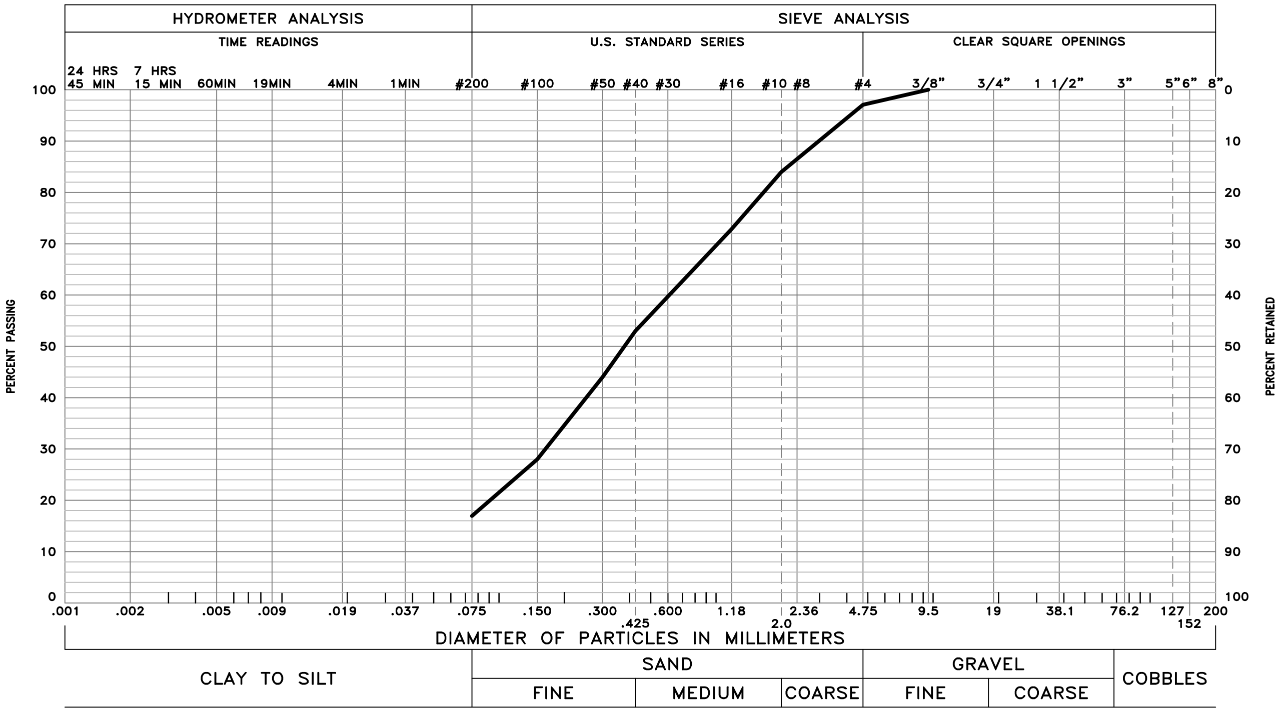
GRAVEL 3 % SAND 76 % SILT AND CLAY 21 %

LIQUID LIMIT 28 PLASTICITY INDEX 10

SAMPLE OF: Fill: Clayey Sand (SC) FROM: Boring 2 @ 1'

These test results apply only to the samples which were tested. The testing report shall not be reproduced, except in full, without the written approval of Kumar & Associates, Inc. Sieve analysis testing is performed in accordance with ASTM D6913, ASTM D7928, ASTM C136 and/or ASTM D1140.

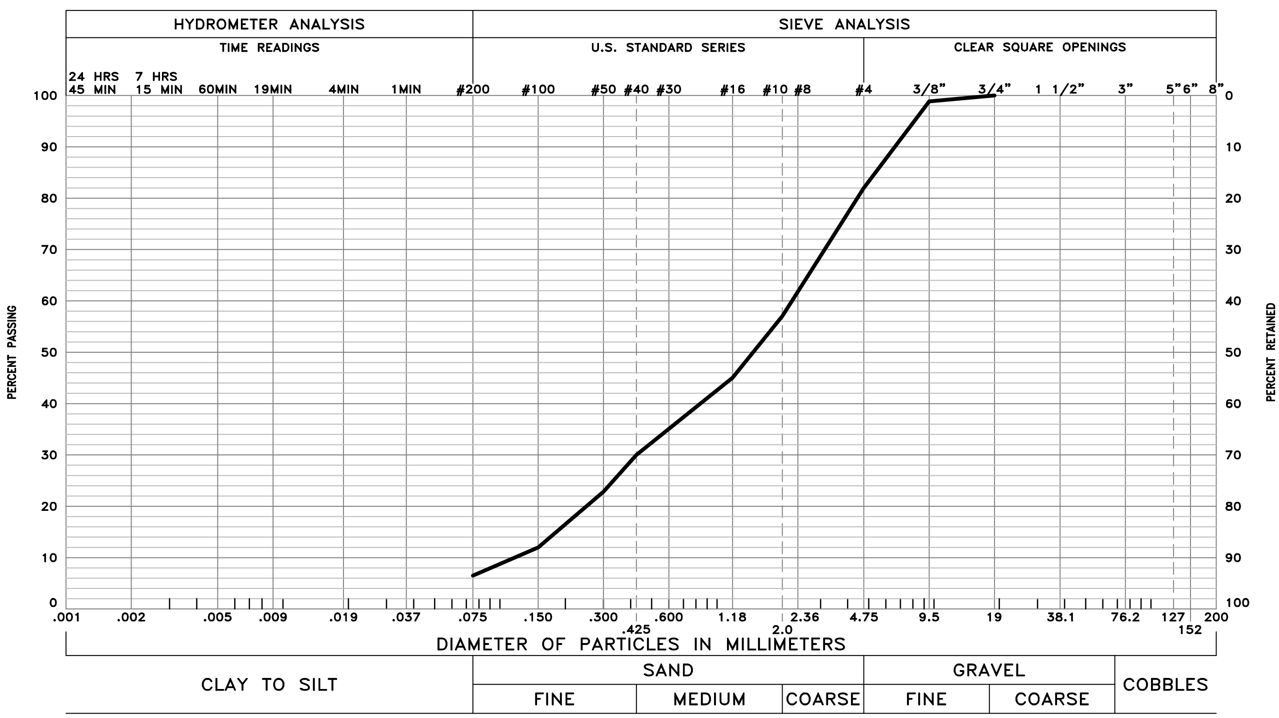
21-2-184	Kumar & Associates	GRADATION TEST RESULTS	Fig. 4



GRAVEL 3 % SAND 80 % SILT AND CLAY 17 %

LIQUID LIMIT 25 PLASTICITY INDEX 8

SAMPLE OF: Fill: Clayey Sand (SC) FROM: Boring 2 @ 2'

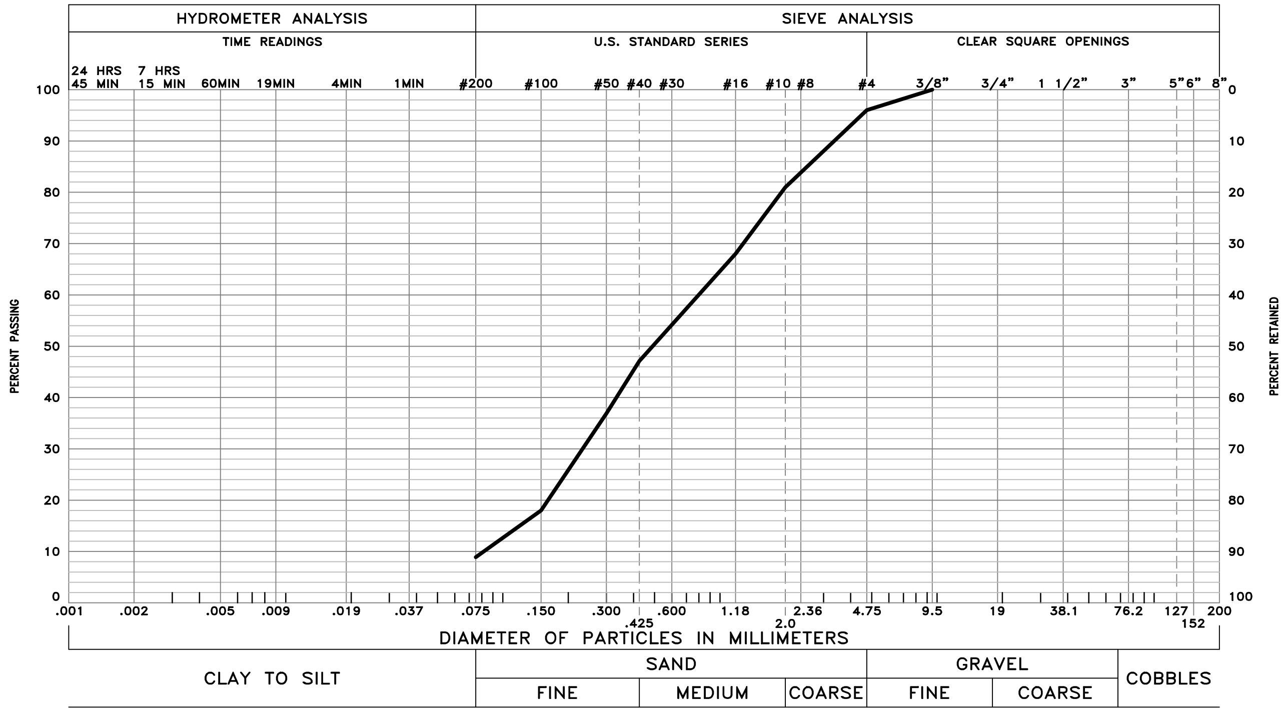


GRAVEL 18 % SAND 75 % SILT AND CLAY 7 %

LIQUID LIMIT NV PLASTICITY INDEX NP

SAMPLE OF: Poorly Graded Sand with Silt and Gravel (SP-SM) FROM: Boring 2 @ 4'

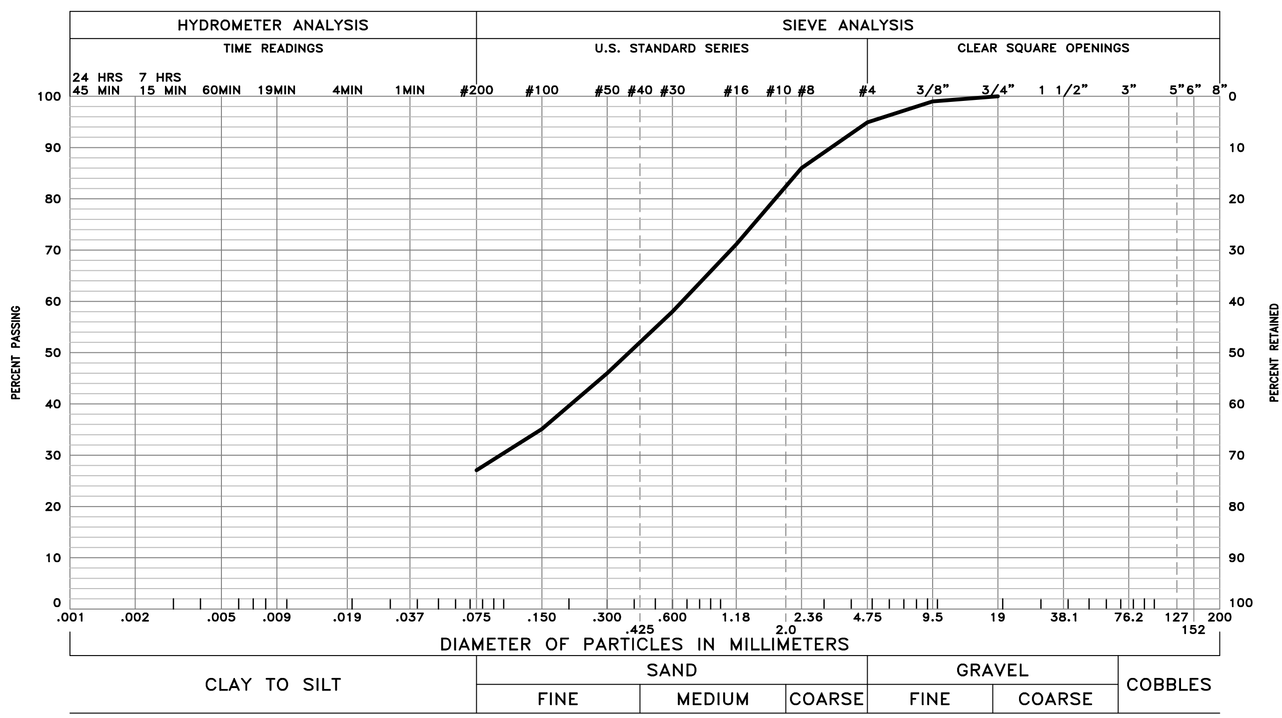
These test results apply only to the samples which were tested. The testing report shall not be reproduced, except in full, without the written approval of Kumar & Associates, Inc. Sieve analysis testing is performed in accordance with ASTM D6913, ASTM D7928, ASTM C136 and/or ASTM D1140.



GRAVEL 4 % SAND 87 % SILT AND CLAY 9 %

LIQUID LIMIT – PLASTICITY INDEX NP

SAMPLE OF: Poorly Graded Sand with Silt (SM) FROM: Boring 3 @ 2'



GRAVEL 6 % SAND 67 % SILT AND CLAY 27 %

LIQUID LIMIT 21 PLASTICITY INDEX 6

SAMPLE OF: Silty, Clayey Sand FROM: Boring 2 @ 0–4.5'

These test results apply only to the samples which were tested. The testing report shall not be reproduced, except in full, without the written approval of Kumar & Associates, Inc. Sieve analysis testing is performed in accordance with ASTM D6913, ASTM D7928, ASTM C136 and/or ASTM D1140.

21–2–184	Kumar & Associates	GRADATION TEST RESULTS	Fig. 6

Kumar and Associates, Inc.

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

Project No.: 21-2-184
Project Name: Liberty Tree Academy
Date Sampled: 6/25/2021
Date Received: 6/28/2021

SAMPLE LOCATION		DATE TESTED	NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		WATER SOLUBLE SULFATES (%)	R-VALUE (300 psi)	AASHTO CLASSIFICATION (Group Index)	SOIL OR BEDROCK TYPE (Unified Soil Classification)
BORING	DEPTH (ft)				GRAVEL (%)	SAND (%)		LIQUID LIMIT	PLASTICITY INDEX				
1	4	7/2/21			10	74	16		NP			A-2-4 (0)	Silty Sand (SM)
2	0-4.5	7/2/21			5	68	27	21	6		30.00	A-2-4 (0)	Silty Clayey Sand (SC-SM)
2	1	7/2/21	11.5	117.6	3	76	21	28	10			A-2-4 (0)	Fill: Clayey Sand (SC)
2	2	7/2/21	11.5	118.8	3	80	17	25	8	0.15		A-2-4 (0)	Fill: Clayey Sand (SC)
2	4	7/2/21	5.9	111.9	18	75	7		NP			A-1-b (0)	Poorly Graded Sand with Silt and Gravel (SP-SM)
3	2	7/2/21	6.7	103.2	4	87	9		NP			A-1-b (0)	Poorly Graded Sand with Silt (SP-SM)

APPENDIX A

(Pavement Design Calculations)

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Kumar & Associates
6735 Kumar Heights
Colorado Springs, CO 80918
USA

Flexible Structural Design Module

COMPOSITE (HMA/ABC)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	788,400	
Initial Serviceability	4.5	
Terminal Serviceability	2	
Reliability Level	85 %	
Overall Standard Deviation	0.45	
Roadbed Soils Resilient Modulus	4940 psi	Design R-value = 20
Stage Construction	1	
Calculated Design Structural Number	3.49 in	

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	6	-	2.64
2	-	0.11	1	8	-	0.88
Total	-	-	-	14.00	-	3.52