CIVIL TECHNICAL SPECIFICATIONS

FOR

Proposed Site Improvements for
ELEVATE
A Conservation Residential Community
Jackson County, N.C.

March 9, 2021
Job #2010J03

Owner:
University Property Group, LLC
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TECHNICAL SPECIFICATIONS

for

Proposed Site Improvements for ELEVATE

University Property Group, LLC - Owner

Jackson County, North Carolina

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SECTION 0900
Report of Geotechnical Exploration

The following geotechnical report dated February 12, 2021 by Kessel Engineering Group, PLLC is intended only for general reference and is not a part of the Contract Documents. Bidders and contractors are responsible for making their own interpretations of data, conducting their own investigations, verifications and reaching their own conclusions regarding physical conditions prior to submitting a bid. The bidder and contractor shall obtain the approval of the owner prior to conducting on site investigations.

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REPORT OF TEST PIT EXPLORATION

ELEVATE DEVELOPMENT – LYLE WILSON ROAD
CULLOWHEE, NORTH CAROLINA

Prepared for:

Ms. Emily Dimitris, Manager
University Property Group, LLC
1944 Hendersonville Road Suite E1
Asheville, NC 28803

Prepared by:

Kessel Engineering Group, PLLC
Asheville, North Carolina

February 12, 2021

KEG Project No. JA20-4106-01

Feburary 12, 2021

Ms. Emily Dimitris, Manager
University Property Group, LLC
1944 Hendersonville Road Suite E1
Asheville, NC 28803

Report of Test Pit Exploration
Elevate Development – Lyle Wilson Road
Cullowhee, North Carolina
KEG Project No. JA20-4106-01

Ms. Dimitris:

Kessel Engineering Group, PLLC (KEG) is pleased to present this report of test pit exploration for the proposed Elevate Development project to be located on Lyle Wilson Road in Cullowhee, North Carolina. The following executive summary provides an overview of the significant geotechnical issues for this project. The summary should not be relied upon exclusively. Specific geotechnical design parameters with a detailed discussion of applications and limitations are provided in the attached report.

EXECUTIVE SUMMARY

The project site consists of three adjoining parcels located on Lyle Wilson Road in Cullowhee, North Carolina and comprising approximately 27.2 acres total. The property consists of primarily mountainous terrain to the north and west of Lyle Wilson Road and primarily flat, wetland terrain to the south and east of Lyle Wilson Road. For the purposes of this report, we have subdivided the property into Area A (a majority of the west/north side of the site), Area B (a small portion of the north central side of the site in close proximity to Lyle Wilson Road), and Area C (the portion of the site primarily to the east/south of Lyle Wilson Road).

Project plans include the construction of 50 total single-family and duplex style residential structures and associated paving and infrastructure. Numerous site retaining walls and cut slopes are planned and will primarily be located in Area A and Area B. A majority of Area C is within several feet of proposed finished grade, and grading work in Area C will consist almost entirely of earthwork fills.

A total of 13 test pits and one (1) hand auger boring were performed in Area A. Below a layer of surficial topsoil and/or rootmat, test locations in Area A typically encountered a shallow layer of colluvium underlain by residual soils. The encountered colluvium consisted of very loose to loose silty sands (SM) and soft to firm sandy silts (ML). Residual soils typically consisted of very loose to very firm silty sands (SM) and firm to stiff sandy silts (ML). Refusal materials were encountered in two (2) test locations but were not widespread. Groundwater was not encountered in test locations in Area A. Conventional shallow foundations bearing on approved residual soils or newly placed engineered fill at Area A may be sized for an allowable design bearing capacity of 2,500 psf, provided the recommendations provided in this report are followed. Grade slabs and pavements may also be supported on residual soils and/or newly placed engineered fill. Some selective undercutting should be anticipated during shallow foundation construction, especially if areas of loose residual soils are encountered. Proofrolling of the site should be utilized to identify areas needing undercutting and replacement. Site retaining wall design must consider global slope stability.

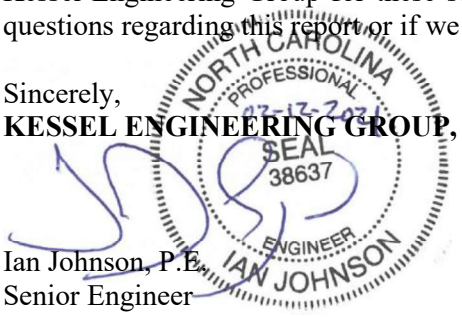
A total of three (3) test pits were performed in Area C. Below a layer of surficial topsoil and/or rootmat, these test pits encountered colluvium consisting of soft to firm sandy silts (ML) to the test pit termination depths of 9 feet. Groundwater was not encountered in test locations in Area B. We recommend soil nail wall(s) be utilized to stabilize proposed excavations in this area prior to construction. Site retaining wall design must consider global slope stability. The encountered colluvium is not suitable for shallow foundation support or support of earthwork fills, pavements, or grade slabs, and we recommend that a supplemental exploration including soil test borings be performed to assist developing additional design recommendations in this area.

A total of ten (10) test pits were performed in Area C. Below a surficial layer of topsoil and/or rootmat, these test pits typically encountered either colluvium or alluvial soils. The colluvium consisted of soft, sandy silts (ML) and was underlain by alluvium. The encountered alluvium consisted of moist to wet, soft to firm sandy silts (ML), wet, very loose to loose silty sands (SM), and soft, wet, lean clay (CL). Groundwater was encountered in each of the test pits performed in Area C, and groundwater control during construction should be anticipated. The encountered soils are not suitable for shallow foundation support or support of earthwork fills, pavements, or grade slabs, and site remediation will be required. This will include utilizing deep foundation systems (timber piles or helical piles) to support proposed buildings. We recommend that a supplemental exploration including soil test borings be performed to assist developing additional design recommendations in this area. Additionally, areas to receive earthwork fills and pavements will require some undercutting and replacement with engineered fill reinforced with biaxial geogrid. Multiple layers of biaxial geogrid may be required.

During site grading, we anticipate that a considerable amount of surficial topsoil or soils with rootmat will likely be generated during construction activities, and consideration should be given to wasting these materials at "green" areas where construction is not planned or at an offsite location. These materials could also be utilized to dress the proposed cut slope faces. Soils encountered in proposed cut locations (primarily within Area A and Area B) appear to generally be acceptable for reuse as engineered fill, with the exceptions noted later in this report. Some moisture conditioning may be required. Soils encountered in Area C were typically very wet, and significant effort and time will be required to reuse these soils as engineered fill.

We appreciate the opportunity to offer our professional geotechnical services on this project. We also provide construction materials testing and Special Inspections services and hope that you will consider Kessel Engineering Group for these services as the project nears construction. Please contact us with questions regarding this report or if we may be of further assistance.

Sincerely,
KESSEL ENGINEERING GROUP, PLLC (NC Firm License No. P-0420)



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SCOPE OF EXPLORATION

The purpose of this exploration was to determine general subsurface conditions at the site and to provide geotechnical recommendations for foundation design and site preparation. This geotechnical exploration was performed in general accordance with our *Proposal for Test Pit Exploration,* KEG Proposal No. PA20-3370-01, dated April 8, 2020 and authorized/received on September 24, 2020. Updated/finalized civil design plans were provided in an email dated January 22, 2021.

PROJECT INFORMATION AND SITE FEATURES

Project information was provided during multiple telephone correspondences and emails between Mr. Victor Lofquist, P.E. and our Mr. Ian Johnson, P.E. Additional project information was gathered during multiple visits to the project site by Mr. Johnson. We have also been provided with the following digital document: *Land Plan for Elevate: A Planned Residential Development*, by Lofquist & Associates, Inc., updated 01/15/2021, and showing the proposed project site layout, building layout, parking lots, site retaining walls, and existing and proposed topographic contours.

The approximately 27.2-acre project site is located on both sides of Lyle Wilson Road in Cullowhee, North Carolina (see Figure 1). The site is comprised of three separate and adjoining parcels (PINs 7558-28-2984, 7558-18-8604, and 7558-18-9344). A single-story residential structure and several out-buildings are present at the south center of the overall property (354 Lyle Wilson Road).

The west half of the project site (north and west of Lyle Wilson Road) is primarily comprised of mountainous, heavily-wooded terrain. The site rises steeply from the roadway until it reaches a localized knob at the north center of the site, and a ridgeline along the western property boundary. Inclinations vary significantly across the west half of the project site, with existing grades as steep as approximately 1.6H:1V (horizontal:vertical) to shallower than 5H:1V.

The east half of the project site (east and south of Lyle Wilson Road) is primarily comprised of wooded terrain with heavy underbrush. Some small clearings are present. Wetland conditions are present throughout much of this area, and existing grades are relatively flat. This half of the project site is bounded by Cullowhee Creek to the east, and smaller springs/creeks are present in this general area.

For the purposes of this report, the project site will be referenced in three (3) separate areas (see Figure 2). "Area A" will comprise a majority of the mountainous, west half of the project site west of Lyle Wilson Road. "Area B" will comprise the smaller north central portion of the project site that is located to the north of Lyle Wilson Road. "Area C" will be comprised of the smaller north central portion of the project site that is located to the south of Lyle Wilson Road, the southeast corner of the project site, and the portion of the site occupied by the existing residential structure at 354 Lyle Wilson Road.

Project plans include construction of approximately 50 total single-family or duplex structures and associated parking, roadways, site retaining walls, and improvements at the project site. 33 structures will be located in Area A (D7 to D23, and S1 to S16), two (2) structures will be located in Area B (D1 to D2), and 15 structures will be located in Area C (D3 to D6, S17 to S27). We have not been provided with architectural or structural plans; however, we understand that buildings located in Area A and Area B will likely be 2-story woodframe structures constructed over grade slabs. Some structures will be constructed with split-levels and daylight basements at the lower-levels. Buildings located in Area C will likely consist of 2-story woodframe structures constructed over crawl-spaces and pier foundations. At this time, structural loading information has also not been provided; however, we have assumed maximum individual column and continuous wall loads on the order of 50 kips and 5 kips per linear foot, respectively.

Based on our review of the provided topographic information, several significant cut slopes (H = 60 to 80 feet) are proposed in Area A and will have inclinations of 2H:1V (maximum excavation depths on the order of 20 feet). The majority of earthwork proposed for Area A will consist of earthwork cuts, with approximately 30 feet deep cuts located in the vicinity of Building D16 at a localized knob feature. Numerous site retaining walls are planned and will retain combinations of earthwork fills and cuts in Area A. A two-tiered site retaining wall system is planned for the north side of Area B and will retain

earthwork cuts. We anticipate that a majority of the site grading at Area B will be comprised of earthwork cuts. Site grading for the north portion of Area C (Buildings D3 to D6) will consist of earthwork fills and site retaining wall construction with maximum fill placements on the order of 6 feet. Site grading in the south portion of Area C (Buildings S17 to S27) will consist of earthwork fills and site retaining wall construction with maximum fill placements on the order of 4 feet.

SITE GEOLOGY

The project site is located in the Blue Ridge Physiographic Province. The bedrock in this region is a complex crystalline formation that has been faulted and contorted by past tectonic movements. The rock has weathered to residual soils which form the mantle for the hillsides and hilltops. The typical residual soil profile in areas not disturbed by erosion or grading consists of clayey soils near the surface where weathering is more advanced, underlain by sandy silts and silty sands.

The boundary between soil and rock is not sharply defined and there is often a transitional zone, termed "partially weathered rock" overlying the parent bedrock. Partially weathered rock (PWR) is defined, for engineering purposes, as residual material with a standard penetration resistance in excess of 100 blows per foot. Weathering is facilitated by fractures, joints, and the presence of less resistant rock types. Consequently, the profile of the partially weathered rock is irregular even over short horizontal distances. Also, it is not unusual to find lenses and boulders of hard rock and/or zones of partially weathered rock within the soil mantle, well above the general bedrock level.

Soils from higher elevations slough and slide down the slopes through the action of gravity. Soils deposited in such a manner are referred to as colluvial soils. Accumulated colluvial soils, or colluvial deposits, may contain features such as perched ground water and planes of weakness on which sliding took place.

Quite often, the upper soils along drainage features and in flood plain areas are water-deposited (alluvial) materials that have been eroded and washed down from adjacent higher ground. Alluvial soils are usually soft and compressible, having never been consolidated by pressures in excess of their present overburden.

Refusal materials encountered in some of the pits performed during this exploration are those materials which are sufficiently hard to prevent the vertical advancement of the excavation equipment. Refusal may result from very dense soils, partially weathered rock, boulders, lenses, ledges, or layers of relatively hard rock underlain by partially weathered rock or residual soil; refusal may also represent the surface of relatively continuous bedrock. Power drilling and core drilling procedures are required to penetrate refusal materials and to determine their character and continuity. Power drilling and core drilling were beyond the scope of this exploration.

FIELD EXPLORATION

Our exploration included performing 26 test pits (TP-1 to TP-12, TP-14 to TP-27) at the approximate locations as indicated on the attached Field Exploration Plan (see Figure 2). Due to very steep terrain limiting access to the excavation equipment, the test location at the proposed TP-13 was instead performed as a hand auger boring (HAB-13). Test pits were located in the field by Mr. Johnson by referencing the provided site plan, identifiable site landmarks, and approximated latitude/longitude coordinates and by utilizing a portable GPS unit.

Test pits TP-1 to TP-12 and TP-14 were located within Area A and were excavated with a John Deere 130G excavator. Test pits TP-16 to TP-18 were located within Area B and were excavated with a Bobcat E35 mini-excavator. Test pits TP-15 and TP-19 to TP-27 were located within Area C and were also excavated with the Bobcat E35 mini-excavator.

The soils encountered by the test pits were identified in the field from cuttings brought to the surface by the excavation equipment. At regular intervals the soil consistency of the encountered materials was measured with a dynamic cone penetrometer (DCP). The conical point was first seated to penetrate any

loose cuttings. It was then driven additional increments of 1¾ inches with blows from a 15 lbs hammer falling 20 inches. The number of blows required to achieve this penetration was recorded. The penetration resistance, once properly evaluated, is an index to the soil strength and foundation supporting capability. At the completion of the field work the test pits were backfilled with the soil cuttings. Soil descriptions are tabulated on the attached Logs. The test locations shown in the appendix should be considered approximate. Test elevations were estimated from the provided topographic information and should also be considered approximate.

Representative portions of the soil samples, thus obtained, were placed in plastic bags and transported to the laboratory. In the laboratory, the samples were examined by a geotechnical engineer to verify the field classifications made by the field crew (ASTM D2488). Two (2) bulk samples were gathered for additional laboratory testing. Soil descriptions and penetration resistances are tabulated on the attached Logs.

LABORATORY TESTING

Two bulk samples (Proctor No. 1, 2) were collected in conjunction with the field work for laboratory testing. Additionally, three bag samples were tested. Additional testing included natural moisture content, Atterberg Limits, and percent fines (percent passing the No. 200 sieve). The laboratory test results of bulk and bag samples are provided in Table 1 below and in the appendix of this report. A summary of testing procedures is provided in the appendix of this report.

TABLE 1
LABORATORY TEST RESULTS

Test Pit No.	Sample Depth (ft)	Maximum Dry Density per ASTM D-698 (pcf)	Optimum Moisture Content per ASTM D-698 (%)	Natural Moisture Content (%)	Percent Passing No. 200 Sieve (%)	Atterberg Limits (LL / PL / PI)	USCS Classificiation
TP-2	1 to 10*	105.2	19.6	17.7	41.1	NP	SM
TP-8	1 to 10*	86.6	28.3	35.1	45.6	NP	SM
TP-19	5**	-	-	41.9	70.7	46 / 39 / 7	ML
TP-20	5**	-	-	31.8	58.4	35 / 34 / 1	ML
TP-21	3**	-	-	29.9	34.1	37 / 34 / 3	SM

*Gathered as bulk samples from test pit. ** Gathered as bag sample
LL = Liquid Limit; PL = Plastic Limit; PI = Plasticity Index; NP = Non-plastic
SM = Silty Sand; ML = Sandy Silt;
- Test not performed.

SUBSURFACE CONDITIONS

General

The descriptions provided below are a summary of the subsurface conditions encountered by the test pits and hand auger boring. Test logs included in the appendix of this report contain information recorded at each test location. The test logs performed for this exploration represent our interpretation of the field logs based on examination of the field samples. The lines designating the interfaces between various strata represent approximate boundaries and the transition between strata may be gradual. It should be noted that soil conditions will vary between test locations.

Area A

Test pits and the hand auger boring performed during this exploration within Area A (TP-1 to TP-12, HAB-13, and TP-14) typically encountered approximately 1 foot of surficial topsoil and rootmat. 11 of these 14 test locations encountered colluvium directly below the topsoil layer to depths of approximately 2 to 6 feet below the existing ground surface. The encountered colluvium consisted of very loose to loose silty sands (SM) and soft to firm sandy silts (ML). The encountered colluvium was underlain by residual soils at each of the test locations. Residual soils typically consisted of very loose to very firm silty sands (SM) and firm to stiff sandy silts (ML).

Test pits performed during this exploration in Area A typically extended to their assigned termination depths of 14 feet below the existing ground surface, with the exceptions of TP-1 and TP-2. TP-1 encountered refusal materials at a depth of 11 feet below the existing ground surface. TP-2 was extended to a deeper termination depth of 19 feet (maximum equipment reach) due to deeper anticipated cuts in this area. Hand auger boring HAB-13 encountered auger refusal at a depth of 8 feet below the existing ground surface. Refusal materials are those materials which are sufficiently hard to prevent the vertical advancement of the excavation equipment or hand auger equipment. Refusal may result from very dense soils, partially weathered rock, boulders, lenses, ledges, or layers of relatively hard rock underlain by partially weathered rock or residual soil; refusal may also represent the surface of relatively continuous bedrock. Power drilling or core drilling procedures are required to penetrate refusal materials and to determine their character and continuity. These services were beyond the scope of this exploration.

Groundwater was not encountered by test pits or the hand auger boring performed in Area A during this exploration at the time of excavation. Groundwater levels may fluctuate several feet with seasonal and rainfall variations. Normally, the highest groundwater levels occur in late winter and spring and the lowest levels occur in late summer and fall.

A summary of existing subsurface conditions encountered by the test pits and hand auger boring performed in Area A during this exploration is provided in Table 2A below.

TABLE 2A
SUMMARY OF SUBSURFACE CONDITIONS ENCOUNTERED BY TEST PITS LOCATED IN AREA A
(MEASURED IN FEET BELOW THE EXISTING GROUND SURFACE)

Test Pit No.	Approx. Existing Elevation (feet MSL)	Approx. Proposed Elevation (feet MSL)	Approx. Proposed Cut Depths (feet)	Approx. Proposed Fill Depths (feet)	Termination Depth (feet)	Topsoil and/or Rootmat (feet)	Colluvium (feet)	Residuum		
								Firm to Stiff SILTS (feet)	V. Loose to Loose SANDS (feet)	Firm to Dense SANDS (feet)
TP-1	2228	2228	-	-	11 (r)	0 to 1	1 to 2	-	2 to 6	6 to 11
TP-2	2270	2240	30	-	19	0 to 1	-	-	1 to 9	9 to 19
TP-3	2230	2230	-	-	14	0 to 1	1 to 4	-	4 to 8	8 to 14
TP-4	2244	2233	11	-	14	0 to 1	-	1 to 2	2 to 6	6 to 14
TP-5	2226	2220	6	-	14	0 to 1	-	1 to 8	-	8 to 14
TP-6	2200	2190	10	-	14	0 to 1	1 to 2	-	2 to 4	4 to 14
TP-7	2204	2186	18	-	14	0 to 1	1 to 2	2 to 6	-	6 to 14
TP-8	2156	2135	21	-	14	0 to 1	1 to 2	-	2 to 4	4 to 14
TP-9	2173	2164	9	-	14	0 to 1	1 to 2	2 to 12	-	12 to 14
TP-10	2168	2167	1	-	14	0 to 1	1 to 2	2 to 14	-	-
TP-11	2200	2193	7	-	14	0 to 1	1 to 6	6 to 14	-	-
TP-12	2194	2186	8	-	14	0 to 1	1 to 2	-	2 to 14	-
HAB-13	2165	2158	7	-	8 (r)	0 to 1	1 to 4	-	4 to 8	-
TP-14	2135	2132	3	-	14	0 to 1	1 to 2	2 to 4	4 to 14	-

- Not encountered in test pit / not applicable.
*See Figure 2 for approximate locations.
(r) = equipment refusal encountered.
Note: Existing and proposed elevations are approximate. Approximate proposed cut/fill depth values shown at test locations. Test location 13 performed as Hand Auger Boring (HAB-13) due to difficult access for excavation equipment.

Area B

Test pits performed during this exploration within Area B (TP-16 to TP-18) typically encountered approximately 1 foot of surficial topsoil and rootmat. Each test pit in this area encountered colluvium directly below the topsoil layer to termination depths of 9 feet below the existing ground surface. The encountered colluvium consisted of soft to firm sandy silts (ML) and contained some trace cobbles.

Groundwater was not encountered by test pits performed in Area B during this exploration at the time of excavation. Groundwater levels may fluctuate several feet with seasonal and rainfall variations. Normally, the highest groundwater levels occur in late winter and spring and the lowest levels occur in late summer and fall. A summary of existing subsurface conditions encountered by the test pits performed in Area B during this exploration is provided in Table 2B below.

TABLE 2B
SUMMARY OF SUBSURFACE CONDITIONS ENCOUNTERED BY TEST PITS LOCATED IN AREA B
(MEASURED IN FEET BELOW THE EXISTING GROUND SURFACE)

Test Pit No.	Approx. Existing Elevation (feet MSL)	Approx. Proposed Elevation (feet MSL)	Approx. Proposed Cut Depths (feet)	Approx. Proposed Fill Depths (feet)	Termination Depth (feet)	Topsoil and/or Rootmat (feet)	Colluvium (feet)	Alluvium (feet)	Residuum (feet)
TP-16	2168	2168	-	-	9	0 to 1	1 to 9	-	-
TP-17	2140	2140	-	-	9	0 to 1	1 to 9	-	-
TP-18	2140	2140	-	-	9	0 to 1	1 to 9	-	-

- Not encountered in test pit / not applicable.
*See Figure 2 for approximate locations.
Note: Existing and proposed elevations are approximate. Approximate proposed cut/fill depth values shown at

Area C

Test pits performed during this exploration within Area C (TP-15, TP-19 to TP-27) typically encountered approximately 1 foot of surficial topsoil and rootmat. Test pits TP-19 to TP-21 (performed in the north portion of Area C) encountered colluvium to depths of approximately 3 to 6 feet below the topsoil layer. This colluvium consisted of soft, sandy silts (ML) and was underlain by alluvium. The remaining test pits performed in Area C (TP-15, TP-22 to TP-27) encountered alluvium directly below the topsoil layer.

The encountered alluvium extended in each pit in Area C to their termination/refusal depths, with the exception of TP-19 and TP-20, which encountered residuum at depths of approximately 8 feet. The encountered alluvium consisted of moist to wet, soft to firm sandy silts (ML), wet, very loose to loose silty sands (SM), and soft, wet, lean clay (CL). A cobble layer was encountered in test pits TP-22, TP-24, TP-26 and TP-27 at depths ranging from approximately 5 to 7 feet below the existing ground surface. Residual soils encountered in test pits TP-19 and TP-20 at depths of 8 feet consisted of wet, loose silty sands (SM).

Test pits TP-19 to TP-23 and TP-27 extended to their assigned termination depths of 9 feet below the existing ground surface. The remaining test pits (TP-15, TP-24 to TP-26) encountered refusal conditions at depths of approximately 6 to 7 feet due to collapsing sidewalls of the excavations.

Groundwater was encountered by each of the test pits performed in Area C during this exploration at the time of excavation. Groundwater depths encountered in these pits ranged from approximately 1.5 to 7 feet below the existing ground surface at time of excavation. Groundwater levels may fluctuate several feet with seasonal and rainfall variations as well as with variations in the adjacent wetland areas and the creek on the east side of the site. Normally, the highest groundwater levels occur in late winter and spring and the lowest levels occur in late summer and fall.

A summary of existing subsurface conditions encountered by the test pits performed in Area C during this exploration is provided in Table 2C below.

TABLE 2C
SUMMARY OF SUBSURFACE CONDITIONS ENCOUNTERED BY TEST PITS LOCATED IN AREA C
(MEASURED IN FEET BELOW THE EXISTING GROUND SURFACE)

Test Pit No.	Approx. Existing Elevation (feet MSL)	Approx. Proposed Elevation (feet MSL)	Approx. Proposed Cut Depths (feet)	Approx. Proposed Fill Depths (feet)	Termination Depth (feet)	Topsoil and/or Rootmat (feet)	Colluvium (feet)	Alluvium (feet)	Residuum (feet)	Ground-water Depth (feet)
TP-15	2122	2124	-	2	6**	0 to 1	-	1 to 6	-	2.5
TP-19	2120	2120	-	-	9	0 to 1	1 to 6	6 to 8	8 to 9	5
TP-20	2122	2126	-	4	9	0 to 1	1 to 4	4 to 8	8 to 9	7
TP-21	2120	2126	-	6	9	0 to 1	1 to 3	3 to 9	-	3
TP-22	2120	2119	1	-	9	0 to 1	-	1 to 9	-	4.5
TP-23	2120	2124	-	4	9	0 to 1	-	1 to 9	-	2
TP-24	2120	2124	-	4	7**	0 to 1	-	1 to 7	-	3
TP-25	2120	2120	-	-	6**	0 to 1	-	1 to 6	-	1.5
TP-26	2120	2122	-	2	6**	0 to 1	-	1 to 6	-	4
TP-27	2120	2124	-	4	9	0 to 1	-	1 to 9	-	1.5

- Not encountered in test pit / not applicable.
*See Figure 2 for approximate locations.
** = equipment refusal encountered due to collapsing sidewalls of test pits.
Note: Existing and proposed elevations are approximate. Approximate proposed cut/fill depth values shown at test

ANALYSES AND DESIGN RECOMMENDATIONS: AREA A

Area A: Shallow Foundations

Based on the test pit data and our experience with similar subsurface conditions, residuum at Area A similar to that encountered in the test pits is suitable for shallow foundation support of the proposed construction. Foundations may also be constructed on newly placed engineered fill constructed as noted in the *Engineered Fill* section of this report. Foundations bearing in residuum similar to that encountered in the test pits with DCP n-values of 7 or higher or in newly placed engineered fill may be sized for an allowable bearing pressure of 2,500 psf. Satisfactory performance of the shallow foundations is subject to the design and site preparation recommendations contained in this report. Some isolated subgrade remediation and/or undercutting may be required if pockets of very loose or soft residual soils are encountered. Foundations should not be constructed atop topsoil or colluvial soils. If encountered, topsoil and/or colluvial soils should be undercut to suitable residuum. We anticipate that a majority of the colluvial soils will be removed during site grading efforts.

We recommend that the minimum widths for individual column and continuous wall footings be 30 and 24 inches, respectively. The minimum widths are considered advisable to provide a margin of safety against a local or punching shear failure of the foundation soils. Exterior and interior footings should bear at least 24 inches and 18 inches, respectively, into residuum or newly placed engineered fill to develop the recommended bearing pressures, provide frost protection, and provide protective embedment.

Footings constructed adjacent slopes (on the downhill side) require additional embedment. We recommend that footings constructed in sloped areas be embedded such that the horizontal distance between the top of the footing and the slope surface is a minimum of 10 feet.

We recommend that walls be provided with regular movement joints to accommodate some possible differential settlement. We note that, dependent on final site layout and FFEs, the need for movement joints should be anticipated to accommodate possible differential settlement where portions of the building(s) may be seated on a combination of very firm/dense residuum/PWR and engineered fill.

Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for long periods of time. Therefore, we recommend that once each footing excavation is extended to final grade, the footing be constructed as soon as possible in order to minimize the potential for damage to bearing soils. The foundation bearing area should be level or benched and free of loose soil, ponded water and debris. Foundation concrete should not be placed on soils that have been disturbed by seepage. If surface water intrusion or exposure softens the bearing soils, the softened soils must be removed from the foundation excavation bottom prior to placement of concrete. If the excavations must remain open for an extended period of time, or if rainfall becomes imminent while the bearing soils are exposed, we recommend that a 2-inch to 4-inch mudmat of lean (2,000 psi) concrete be placed on the bearing soils before the placement of reinforcing steel for protection.

In order to verify that the soils encountered in footing excavations are similar to the residuum encountered by the test pits or are approved newly placed engineered fill, we recommend that foundation excavations be examined and checked with a dynamic cone penetrometer by an engineering technician working under the direction of the geotechnical engineer.

Area A: Grade Slabs & Pavements

Based on the test pit data and our experience with similar soils, onsite residual soils and newly placed engineered fill are suitable for support of grade slabs and pavements assuming that the site is prepared in accordance with the recommendations in this report. Topsoil and colluvium are generally not suitable for support of grade slabs and pavements and should be undercut to approved residuum and brought back to design grade with engineered fill. Areas to support grade slabs and pavements should be proofrolled (as described below) prior to grade slab or pavement construction. The implementation of remedial measures, such as undercutting and replacing with new engineered fill, will be required if unsuitable soils are encountered during proofrolling performance testing.

Grade slabs should be jointed around columns and along footing supported walls so that the slab and foundations can settle differentially without damage. If slab thickness permits, joints containing dowels or keys may be used in the slab to permit movement between parts of the slab without cracking or sharp vertical displacements. Completed slabs should be protected from excessive surface moisture prior to and during periods of prolonged below-freezing temperatures to prevent subgrade freezing and resulting heave. For grade slabs bearing on a combination of engineered fill and refusal materials (if encountered), over-excavation of the refusal materials approximately 12-inches and replacement with compacted engineered fill to provide a cushion is recommended.

If building pad subgrades are to be exposed to construction traffic or inclement weather for an extended period of time, it may be advantageous to overbuild the pad during initial grading or to place a granular material (such as an aggregate base course material) across the subgrade to help minimize deterioration.

Floor slabs supported on grade which will be carpeted, tiled, painted, or receive some other covering or sealant should incorporate a vapor barrier. At a minimum, the vapor barrier should be installed in accordance with the guidelines outlined in Chapter 3 of ACI Publication 302.1 (*Guide for Concrete Floor and Slab Construction*).

Other general recommendations for pavement construction are provided later in this report.

Area A: Lateral Earth Pressures

Site retaining walls must be capable of resisting the lateral earth pressures that will be imposed on them. Based on our experience with similar soils, the following effective stress properties are recommended for use during preliminary site retaining wall design. For walls retaining undisturbed residuum similar to that encountered in the test pits, we recommend an angle of internal frication value of 30 degrees, a cohesion value of 100 psf, and a soil unit weight of 120 pcf. For low plasticity (PI < 10), onsite silty sands or sandy silts such as those encountered in the test pits and used as engineered fill, we recommend an angle of internal friction value of 28 degrees, a cohesion value of 25 psf, and a soil unit weight of 125 pcf be utilized to calculate lateral earth pressure coefficients.

In lieu of using soil backfill, select backfill consisting of No. 57 stone may be used to reduce lateral earth pressures on the walls. No. 57 stone placed against retaining walls as select fill should extend from the base of the walls in a wedge with an angle of 45 degrees or shallower from horizontal in order that the following parameters may be used to reduce lateral earth pressures. For select backfill consisting of No. 57 stone, we recommend an angle of internal friction value of 38 degrees, a cohesion value of 0 psf, and a soil unit weight of 105 pcf be utilized to estimated lateral earth pressure coefficients. Passive earth pressures should not be developed with No. 57 stone. Non-woven, needle-punched geotextile filter fabric (such as Mirafi 140N or equivalent) should be used to separate No. 57 stone from adjacent soils and prevent migration of fines into the stone. No. 57 stone must be placed such that it is permanently confined.

Frictional resistance along the base of wall foundations may be used to resist sliding. We recommend a coefficient of frictional resistance (f_s) value of 0.36 for retaining wall foundations bearing in undisturbed on-site residual soils and 0.33 for foundations bearing in engineered fill.

Lateral pressure arising from sloping fill surfaces, surcharge loading, earthquake loading, and groundwater (not expected within wall construction depths) will dramatically influence the earth pressure coefficients and should be included in the calculation of the total lateral pressures that the walls must resist. In addition, transient loads imposed on the walls by construction equipment during grading should be taken into consideration during design and construction. Excessively heavy grading equipment should not be allowed within about 10 horizontal feet of the walls. The design of retaining walls constructed on steeply sloping sites is often governed by global stability.

The design of site retaining walls should take global stability into account, especially where these walls are located on/adjacent to slopes or are retaining sloping conditions. The site retaining wall design engineer should be a licensed professional engineer registered in the State of North Carolina. The design engineer should be provided a copy of this report prior to final design of these walls. Design of site retaining walls near the toe of proposed cut slopes (e.g. Wall #12, #16, etc.) should carefully consider the temporary excavation conditions required to install the site retaining wall at the base of the slope(s). Site retaining wall construction must not destabilize proposed cut slopes.

Provisions for the drainage of water which collects behind the retaining structures must be provided. The drainage system should have sufficient capacity to prevent the buildup of excess hydrostatic head behind the walls. The drainage system should incorporate appropriately graded sand or aggregate material and geotextile fabric to prevent the loss of fines which could be transported in the drainage system. Drain cleanouts should be provided.

The preceding values are based on our experience and testing of reasonably similar soils. Sloping backfill (or sloping soil surfaces in front of a footing when considering passive resistance) will dramatically influence lateral earth pressures. Kessel Engineering Group should be consulted concerning applicable earth pressure coefficients where sloping soil surfaces may be present.

Area A: Difficult Excavations

Based on the proposed grading elevations, proposed building finished floor elevations, and the test pit data, we do not anticipate that difficult excavations will be widespread across a majority of the project site. However, refusal materials were encountered at test pit TP-1 (at a depth of 11 feet below proposed grade). Additionally, multiple locations are present where the proposed excavation depths are up to 5 to 11 feet deeper than the pit termination depths. As previously noted, the profile of the PWR can be irregular even over short horizontal distances, and difficult excavations may occur where the deepest proposed excavations are present. Performance of soil test borings could assist in further determining the extent and characteristics of these materials. Difficult excavations should be anticipated in dense and very dense soils, PWR, and refusal materials. Where difficult excavations are anticipated, adjustments to the grading plan could help reduce the extent of difficult excavations.

Heavy excavation equipment and heavy excavation equipment with ripping tools will be able to remove some of these materials. The ease of excavation of these materials cannot be specifically quantified and depends on the quality of grading equipment, skill of the equipment operators and geologic structure of the material itself, such as the direction of bedding, planes of weakness and spacing between discontinuities. In a large open excavation site such as this project site, resistant areas could be approached from multiple directions with the ripper and thus align with a plane of weakness, facilitating excavation efforts.

Light blasting may be necessary to efficiently remove more resistant areas of PWR and refusal materials. Prior to any blasting efforts, we recommend that adjacent properties be "blast-surveyed" to identify any pre-existing structural distress/cracks that should not be associated with potential blasting that may be required at the project site.

Confined excavations (footings, utility trenches, etc.) through PWR may require light blasting. In areas where difficult excavation is encountered, consideration should be given to mass excavating below the design subgrade level to the bottom elevation for utilities and foundations, as boulders, rock lenses and massive rock could be more easily and more economically removed in a mass form than by local excavation. Also, depending upon the construction schedule, there may be a time advantage to completing a majority of rock excavation during mass grading. Over-excavated areas could be backfilled with engineered fill (described below), after which foundations and utility lines could then be excavated routinely.

ANALYSES AND DESIGN RECOMMENDATIONS: AREA B

Area B: Colluvial Deposits & Soil Nailing

As previously mentioned, below a surficial layer of topsoil and rootmat, test pits performed within Area B encountered colluvial soils. Colluvial soils extended a minimum of 9 feet deep in this area (extent of equipment reach). The presence of colluvium (landslide material) at this portion of the site indicates that the existing natural slope has experienced past movement. The presence of a colluvial layer is fairly common on steep natural slopes as near-surface soils weather and creep downhill. Colluvial soils are generally considered unstable as they may contain planes of weakness on which past sliding took place.

Performing excavations in a colluvial deposit (such as for construction of site retaining walls or below-grade basement walls) or surcharging a colluvial deposit by placing structures, retaining walls, and/or earthwork fills atop the colluvium will reduce the already-marginal factor of safety for localized and global stability of site slopes in Area B. An excavation, cut, or removal of soils from the colluvial deposit would reduce the already-marginal factor of safety for slope stability for slopes above the excavation, as the in-place soils serve to partially buttress the movement of soils from higher elevations.

Based on the encountered soil conditions, the site topography, and our experience with similar conditions, it is our opinion that excavations required for construction of the uphill site retaining walls and basement walls will be unstable. Additionally, the colluvium at Area B has the potential to creep downhill at a

relatively slow rate, leading to potential long-term lateral loading and associated distress to proposed structures. It is our opinion that soil nailing is the best option for permanently stabilizing the excavation cuts in Area B prior to site grading and construction of Buildings D1 and D2.

Soil nailing is a method of earth reinforcement which is constructed in stages. Each stage of excavation consists of an approximately four-foot vertical excavation, followed by placement of soil nails and application of reinforced shotcrete. This sequence is repeated in stages to achieve the total depth of excavation required. Soil nails are used to create a mass of soil which then behaves as a gravity retaining wall to resist lateral earth pressures. Soil nail walls should be designed and constructed by specialty contractor specializing in soil nailing. Soil nail walls should be designed by a professional engineer licensed in the state of North Carolina and must consider long-term global stability of the project site in Area B.

As noted above, test pits in Area B (TP-16 to TP-18) extended 9 feet below existing grade and did not encounter residual soils. Prior to further design in this area, it is recommended to perform additional deeper subsurface exploration in this area consisting of soil test borings, undisturbed sampling, and possible laboratory testing (e.g. CU triaxial shear testing). This additional data would assist in determining final design parameters for the proposed soil nail wall construction and could assist with feasibility analyses in this area.

Area B: Foundations, Grade Slabs, and Pavements

The colluvium encountered at the site (as well as surficial topsoil and rootmat) will also not provide adequate subgrade support of building foundations, basement retaining walls, grade slabs, pavements or earthwork fill. Surcharging a colluvial deposit by placing structures, pavements, and/or earthwork fills atop the colluvium will reduce the already-marginal factor of safety for localized and global stability of site slopes.

As noted above, it is recommended to perform a supplemental subsurface exploration in this area (consisting of soil test borings) to assist in determining the depth to residuum and which foundation, grade slab, and pavement recommendations are most feasible. Depending on results from this supplemental exploration, it may be determined that building foundations can be supported on either 1.) shallow foundations on approved residuum (if encountered) or engineered fill constructed after a mass excavation of the colluvium, or 2.) a system of deep foundations likely consisting of either micropiles, helical anchors, or driven piles.

Careful consideration should be given to site grading plans, proposed finished floor elevations, and implementation of soil nail walls prior to performing earthwork at the Area B portion of the project site. Long-term global stability of site retaining walls and associated slopes in the area must be considered during design.

ANALYSES AND DESIGN RECOMMENDATIONS: AREA C

Area C: General Notes

As previously mentioned, below a surficial layer of topsoil and rootmat, test pits performed within Area C encountered colluvial soils or alluvial soils, which typically extended to the termination or refusal depths of the test pits. Colluvial and alluvial soils encountered in the test pits typically exhibited soft or very loose soil consistencies ($n \leq 4$) to termination or refusal depths of 6 to 9 feet. Additionally, shallow groundwater was encountered in these test pits approximately 1.5 to 7 feet below the existing ground surface, and soils in these pit locations were typically moist to wet.

Based on our experience with similar conditions, the subsurface conditions encountered at the site within Area C indicate that conventional shallow foundations are not a suitable option for support of the proposed structures. Deep foundations will be required to support the proposed structures. Additionally, recommendations are provided for support of pavements and grade slabs in this area.

As noted above, test pits in Area C typically extended 9 feet below existing grade and did not encounter residual soils (with the exceptions of TP-19 and TP-20). It is recommended to perform an additional deeper subsurface exploration in this area consisting of soil test borings. This additional data would assist in determining final design parameters for the proposed deep foundations and could assist with feasibility analyses in this area.

We recommend that footings, pile caps, and/or grade beams should bear at least 24 inches below final exterior grade to provide frost protection and protective embedment. We recommend that walls be provided with regular movement joints to accommodate some possible differential settlement.

Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for long periods of time. Therefore, we recommend that once each footing/pile cap/grade beam excavation is extended to final grade, the member be constructed as soon as possible in order to minimize the potential for damage to bearing soils. The foundation bearing area should be level or benched and free of loose soil, ponded water and debris. Foundation concrete should not be placed on soils that have been disturbed by seepage. If surface water intrusion or exposure softens the bearing soils, the softened soils must be removed from the foundation excavation bottom prior to placement of concrete. If the excavations must remain open for an extended period of time, or if rainfall becomes imminent while the bearing soils are exposed, we recommend that a 2-inch to 4-inch mudmat of lean (2,000 psi) concrete be placed on the bearing soils before the placement of reinforcing steel for protection.

Area C: Deep Foundations Option 1: Timber Piles

The proposed structures could be supported by pile caps and grade beams supported by timber piles. The quality of timber piles should meet the requirements of ASTM D-25 for round timber tip bearing piles and conform with applicable building codes. Piles must meet project specifications with respect to length, butt and tip diameter, sapwood, straightness, twist of grain, knots, pressure treatment and should be relatively free of defects and have water content greater than approximately 20 percent (to minimize "breaking") and less than about 50 percent (to minimize "brooming"). After the pile butt has been cut off after installation, chemical additives should be used to treat the cutoff surface to prevent organic degradation.

Piles should be driven continuously to the recommended bearing material of very firm or better residual soils, PWR, or refusal materials. The initial driving resistance should be determined by an acceptable dynamic pile driving formula that considers the weight of the pile. The Wave Equation is recommended. Compatibility of the pile driving equipment and the pile type being driven is an essential element in achieving the required penetration and a satisfactory pile foundation.

Timber piles have the advantage of being readily available and relatively easily cut-off to accommodate length variations. They are also easy to handle and the tapered sections provide higher resistance in granular soils than uniform piles. They have the disadvantage, however, of being more difficult to splice and having lower axial capacity than comparable steel or prestressed concrete piles.

We recommend that a specialty contractor with experience in timber pile design and installation and working under a "design/build performance" specification be retained to install the foundation system. The timber pile design should be provided by a professional engineer licensed in the State of North Carolina. The bidding foundation contractors should be provided a copy of this report.

Pile load testing for pile capacities should be implemented for the purpose of assisting in the development of final tip elevations and to confirm that the contractor's equipment and installation methods are acceptable. The test program should involve test piles to provide an indication of various driving and/or installation conditions. The Owner's Special Inspector should monitor the driving of these test piles. Depending on the resistance to penetration during initial driving, the geotechnical engineer may require some or all of the test piles to be re-tapped following a waiting period of 24 to 48 hours to check for pile/soil setup. Provisions of ASTM D-1143 may be used as a guide in the conduct of the load tests and

modified as required by the North Carolina code. Pre-production verification load testing should be performed prior to production, and an adequate number of production members should be tested to confirm design capacities are being achieved. Load test settlement measurements should be within tolerances and in general conformance with industry standards.

Area C: Deep Foundations Option 2: Helical Piles

As an alternative to timber piles, helical piles could be considered. Helical piles consist of single flights of screw helix along a shaft installed with rotary installation equipment. They can be installed in relatively confined areas and the installation produces minimal vibration. The shafts are designed to withstand the compressive and tensile foundation loads which are then transferred through the colluvial and alluvial layers to suitable bearing materials (i.e., underlying firm residual soils, partially weathered rock and/or rock). Should the soils be corrosive, special coatings are applied at the time of installation or cathodic protection can be used. Torque value should be monitored during installation to estimate soil consistency as the helix penetrates through the different subsurface strata. Helical piles should be designed to limit total and differential settlement of foundations to 1-inch and ½-inch, respectively.

Due to the soft and very loose soil profile encountered at the test pit locations, buckling of the slender helical pile sections may be the controlling factor for design. The use of thicker steel sections, large wall diameter, inclined piles, or some combination thereof may be required to control buckling and to provide lateral stability for the pile caps. Allowable capacities on the order of 25 to 30 kips per pile can be utilized in initial feasibility planning; however, the final design capacity should be determined by the design engineer as described below.

We recommend that a specialty contractor with experience in helical pile design and installation and working under a "design/build performance" specification be retained to install the foundation system. The helical pile design should be provided by a professional engineer licensed in the State of North Carolina. The pile spacing, sizing, and connections to proposed footings should be determined/designed by the design engineer. The bidding foundation contractors should be provided a copy of this report.

The helical pile installation QC program should be monitored full time by the Owner's Special Inspector within the scope of the project Statement of Special Inspections. The QC program would include conducting verification of placement, installation depths, and observed torque/pressure. These items should be documented for each helical pile element installed to provide a complete record of foundation quality.

The successful installation of helical piles to suitable bearing materials can sometimes be hindered and/or prevented due to the presence of cobbles and/or boulders found within the alluvial strata (if present). Some shallow cobble layers were observed in the pits excavated in this area. As noted above, it is recommended to perform soil test borings at the site to assist in determining deeper subsurface conditions.

Area C: Grade Slabs, Pavements & Earthwork Fills

Topsoil, colluvium, and alluvium encountered by the test pits in Area C are generally not suitable for direct support of grade slabs, pavements, and earthwork fills. After removal of the topsoil layer, areas to support grade slabs, pavements, and earthwork fills should be proofrolled (as described below) prior to construction. Extreme caution should be utilized when proofrolling this area, and proofrolling should not be performed on very wet subgrades.

The implementation of remedial measures, such as undercutting and replacing with new engineered fill, will be required if unsuitable soils are encountered during proofrolling performance testing. It should be anticipated that remediation will be required across a majority of Area C where grade slabs, pavements, and earthwork fills are planned. The need for subgrade improvement should be determined in the field by the Geotechnical Engineer during construction on a case-by-case basis; however, for planning purposes, the Contractor should anticipate typical undercuts of 2 feet below existing grade, and two (2) layers of

biaxial geogrid (Tensar BX1200 or approved equivalent). It is likely that biaxial geogrid will be required in order to successfully place earthwork fills and achieve the recommended compaction.

When possible, it will likely be advantageous to lower the groundwater table (as noted below) as much as possible to facilitate fill placement. Alternatively, performance of site work during traditionally drier, warmer months could help minimize extended exposure of the subgrade to environmental elements.

Other general recommendations for grade slab are provided in the *Area A: Grade Slabs & Pavements* section of this report. Other general recommendations for pavements are provided in the *Pavements* section of this report below.

Area C: Lateral Earth Pressures

Site retaining walls must be capable of resisting the lateral earth pressures that will be imposed on them. Based on our experience with similar soils, the following effective stress properties are recommended for use during preliminary site retaining wall design. For walls retaining low plasticity (PI < 10), onsite silty sands or sandy silts such as those encountered in the test pits and used as engineered fill, we recommend an angle of internal friction value of 28 degrees, a cohesion value of 25 psf, and a soil unit weight of 125 pcf be utilized to calculate lateral earth pressure coefficients.

In lieu of using soil backfill, select backfill consisting of No. 57 stone may be used to reduce lateral earth pressures on the walls. No. 57 stone placed against retaining walls as select fill should extend from the base of the walls in a wedge with an angle of 45 degrees or shallower from horizontal in order that the following parameters may be used to reduce lateral earth pressures. For select backfill consisting of No. 57 stone, we recommend an angle of internal friction value of 38 degrees, a cohesion value of 0 psf, and a soil unit weight of 105 pcf be utilized to estimated lateral earth pressure coefficients. Passive earth pressures should not be developed with No. 57 stone. Non-woven, needle-punched geotextile filter fabric (such as Mirafi 140N or equivalent) should be used to separate No. 57 stone from adjacent soils and prevent migration of fines into the stone. No. 57 stone must be placed such that it is permanently confined.

Frictional resistance along the base of wall foundations may be used to resist sliding. We recommend a coefficient of frictional resistance (f_s) value of 0.33 for foundations bearing in engineered fill.

Lateral pressure arising from sloping fill surfaces, surcharge loading, earthquake loading, and groundwater (not expected within wall construction depths) will dramatically influence the earth pressure coefficients and should be included in the calculation of the total lateral pressures that the walls must resist. In addition, transient loads imposed on the walls by construction equipment during grading should be taken into consideration during design and construction. Excessively heavy grading equipment should not be allowed within about 10 horizontal feet of the walls.

Provisions for the drainage of water which collects behind the retaining structures must be provided. The wall designer should anticipate groundwater or floodwater infiltration into the site retaining wall backfill zones. The drainage system should have sufficient capacity to prevent the buildup of excess hydrostatic head behind the walls. The drainage system should incorporate appropriately graded sand or aggregate material and geotextile fabric to prevent the loss of fines which could be transported in the drainage system. Drain cleanouts should be provided.

The preceding values are based on our experience and testing of reasonably similar soils. Sloping backfill (or sloping soil surfaces in front of a footing when considering passive resistance) will dramatically influence lateral earth pressures. Kessel Engineering Group should be consulted concerning applicable earth pressure coefficients where sloping soil surfaces may be present. The site retaining wall design engineer should be a licensed professional engineer registered in the State of North Carolina.

ANALYSES AND DESIGN RECOMMENDATIONS: GENERAL NOTES

Topsoil and Rootmat

As noted in the logs, approximately 12 inches of surficial topsoil and/or soils containing rootmat were encountered in the test locations performed during this exploration. This value will likely vary considerably across the project site. We anticipate that a considerable amount of surficial topsoil or soils containing significant volumes of rootmat will be generated during site grading activities, and balancing of site grading calculations should take these volumes into consideration.

These materials should be wasted offsite or placed in proposed "green" areas where current construction is not planned. Future construction in these areas will first require removal of these materials. Alternatively, topsoil can often be stockpiled and later used to "dress" the face of cut slopes to help with erosion control. A maximum topsoil thickness of 6 to 12 inches should not be exceeded to help avoid the potential for shallow slope failures within the topsoil layer.

Pavements

Pavements may be soil supported by residual soils or newly placed engineered fill assuming that the site is prepared in accordance with the recommendations presented in this report. Areas to support pavements should be proofrolled (as described below) prior to pavement construction. The implementation of remedial measures, such as undercutting and replacing with new engineered fill and/or the use of biaxial geogrid reinforcement (e.g. BX1200 or approved equivalent), may be required if very soft/loose soils are encountered by proofrolling tests.

A site-specific pavement design requires detailed information about projected traffic frequency and intensity, acceptable service limits, life expectancy and other factors. It also requires site specific laboratory testing which was not part of the scope of this exploration. We have presented below recommended pavement sections based on our experience on similar projects in this region. Assuming the site is prepared in accordance with the recommendations of this report, the pavement sections presented in Table 3 below could be expected to provide adequate performance assuming a 20-year service life.

TABLE 3
RECOMMENDED PAVEMENT SECTIONS

Pavement Type	Layer	Material	Thickness (inches)
Flexible (Light Duty)	Surface	SF-9.5B or SF-9.5C Superpave	2.0
	Base	Aggregate Base Course	8.0
Flexible (Heavy Duty)	Surface	SF-9.5B Superpave	2.0
	Intermediate	I-19.0B Superpave	2.0
	Base	Aggregate Base Course	8.0
Rigid	Surface	Portland Cement Concrete	6.5
	Base	Aggregate Base Course	6.0

The asphalt surface and intermediate courses should conform to the North Carolina Department of Transportation (NCDOT) Standard Specification, Section 610, for Type SF-9.5B, SF-9.5C, and I-19.0B Superpave mixtures. The base course material should be Aggregate Base Course conforming to NCDOT Standard Specification, Section 520. The base course should be compacted to at least 100 percent of the modified Proctor (ASTM D 1557) maximum dry density.

Our experience on similar projects is that asphaltic pavements are insufficient to handle wheel loads of waste disposal trucks adjacent to trash dumpsters. We recommend that a rigid pavement section be used in these areas. The rigid pavement section should extend beyond the dumpsters such that all wheels of the waste disposal trucks are supported by the rigid pavement section during loading/unloading of the dumpster units.

The concrete for rigid pavement should be air-entrained and have a minimum flexural strength (third point loading) of 550 psi which could likely be achieved by a concrete mix having a compressive strength of at least 4,000 psi at 28 days. Recommended air contents from the Portland Cement Association (PCA) are as follows:

Maximum Aggregate Size	Percent Air
1½ inches	5 percent plus or minus 1½ percent
¾ to 1 inch	6 percent plus or minus 1½ percent

In addition, we recommend a maximum slump of 4 inches. The civil designer should provide recommendations for steel reinforcement of rigid concrete pavements.

Joint spacing for this concrete thickness should be on the order of 12 to 15 feet. Control joints should be sawed as soon as the cut can be made, without raveling (aggregate pulling out of the concrete matrix) or cracks forming ahead of the saw blade. Joints should be sawed consecutively to ensure all commence working together. The American Association of State Highway and Transportation Officials (AASHTO) suggests that transverse contraction joints should be one quarter of the slab thickness and longitudinal joints should be one third of the slab thickness. All joints should be filled with flexible joint filler.

Curing of the concrete slab should begin as soon as the slab has been finished and the joints sawed. Moist curing by fog spray nozzles or wet burlap is the most dependable curing procedure. Other methods of curing could consist of spray applied curing compounds or covering the slab with waterproof paper or heavy plastic. If paper or plastic is used for curing, the edges of the cover should be anchored and joints between sheets should be taped or sealed.

Related civil design factors such as subgrade drainage, shoulder support, cross-sectional configurations, surface elevations, and environmental factors which will significantly affect the service life must be included in the preparation of the construction drawings and specifications. Normal periodic maintenance will be required.

Secondary Design Considerations

The following items are presented for your consideration:

- Roof drainage should be collected by a system of gutters and downspouts and piped away from structures (buildings, pavements, retaining walls, etc.).
- Site grading and paving should result in positive drainage away from the structures. Water should not be allowed to pond around the structures or in such locations that would lead to saturation of structure subgrade materials. A minimum slope of approximately ¼ to ½-inch per foot should provide adequate drainage.
- Backfill for utility lines should be placed in accordance with the requirements for engineered fill to minimize the potential for differential settlement.

These items are known to generally enhance performance of structural systems.

SITE PREPARATION AND CONSTRUCTION RECOMMENDATIONS

Clearing and Grubbing

Existing topsoil, vegetation, and soils containing organic matter or other deleterious materials should be removed from the area of the proposed construction. Organic soils may be stockpiled for later use in areas to be landscaped. Stumps and other deleterious materials should be disposed of offsite or in areas of the site that will not be developed. Future construction of earthwork fills, retaining walls, structures, grade slabs, or pavements in areas containing organic soils or other deleterious materials will first require that these materials be removed.

Abandoning Existing Structures and Utilities

Existing site features such as buildings and other features at 354 Lyle Wilson Road are to be demolished prior to construction. Existing utilities will also require relocation or abandonment. Existing abandoned utilities should be removed and the resulting trenches filled with engineered fill, or abandoned utilities should be plugged prior to construction. If pipes are not removed or plugged, they may serve as conduits for subsurface erosion resulting in settlement. Trench backfill over left-in-place utility lines may require densification or replacement. Footings from demolished buildings should be removed and replaced with compacted engineered fill or flowable fill.

Engineered Fill

Fill used for raising site grades, retaining wall backfill, or for replacement of undercut materials should be uniformly compacted in thin lifts (8-inch to 10-inch loose measure) to at least 95 percent of the standard Proctor maximum dry density (ASTM D-698) and within ±3% of the material's optimum moisture content. In addition, the upper 18 inches of subgrade fill beneath grade slabs and pavements should be compacted to at least 98 percent of the same specification. Larger loads during construction such as for materials storage or forklift and truck traffic should be considered in design of slabs and may require greater compaction of subgrade fill. Engineered fill placed at existing slopes should be properly benched into residuum at the existing slopes prior to compaction.

Based on visual examination, laboratory testing, and our experience with similar soils, the on-site soils generally appear to be suitable for use as engineered fill, provided these materials are free of topsoil, organics and debris. Some moisture adjustment will likely be required and would likely require drying of the soils, especially if those from Area C are reused as engineered fill.

Soils utilized as engineered fill should have a maximum dry density as determined in accordance with ASTM D698 (Standard Proctor test) of at least 90 pcf (at least 95 pcf is preferable). Please note that soils gathered at TP-8 exhibited a maximum dry density value of 86.6 pcf (see Table 1). Soils with maximum dry densities of less than 90 pcf are generally highly susceptible to deterioration when loaded by building foundations, structural slabs, pavements, and construction traffic. It can also be very difficult to achieve proper compaction due to these materials' high sensitivity to variations in moisture. If encountered during site grading, we recommend soils with maximum dry densities of less than 90 pcf be stockpiled and either utilized in deeper fill areas and elevations (not in upper 10 feet of fill zones) or removed offsite. These low-density soils should not be utilized to construct structural fill slopes.

Soils having a Plasticity Index (PI) greater than 30 (less than 15 is preferable) should not be used for fill. Before filling operations begin, representative samples of each proposed fill material should be collected and tested to determine the compaction and classification characteristics. The maximum dry density and optimum moisture content should be determined. Two bulk samples have been tested and are included in the appendix of this report. Once compaction begins, a sufficient number of density tests should be performed by an engineering technician working under the direction of the geotechnical engineer to measure the degree of compaction being obtained.

In areas where more than 10 feet of engineered fill will be placed to achieve proposed grades (i.e., at the north end of the project site), we recommend that construction of structures and pavements be delayed to allow time for the underlying soils and fill to "settle out" as they adjust to the overlying weight of materials. Settlements on the order of 1 inch for each 10 feet of fill placed are anticipated for fills constructed with silty sands or sandy silts similar to those encountered in the test pits. In the deepest fill areas, a period of 2 to 3 weeks may be required for this adjustment. Settlement monuments installed along the surface of the completed fill surface and monitored with precision leveling/surveying equipment would aid in determining when settlements are negligible and construction could begin.

The surface of compacted subgrade soils can deteriorate and lose its support capabilities when exposed to environmental changes or construction activity. Deterioration can occur from, but is not limited to, the effects of freezing temperatures, the formation of erosion gullies, exposure to extreme drying conditions, long term exposure to natural elements, and rutting caused by construction traffic. We recommend that surfaces of the subgrade that have deteriorated or softened be recompacted immediately prior to construction of grade slabs. Additionally, excavations through the subgrade soils, such as utility trenches, should be properly backfilled with compacted lifts of engineered fill. Recompaction of subgrade surfaces and compaction of backfill should be checked with a sufficient number of density tests to determine if adequate compaction is being achieved.

Proofrolling

We recommend that areas to provide support for engineered fill, pavements and grade slabs be observed for soft soils and proofrolled with a 25 to 35 ton, four wheeled, rubber tired roller or similar approved equipment. Prior to placement of engineered fill, the areas should be proofrolled with an empty, four wheeled, rubber-tired dump truck. If the areas successfully pass proofrolling with an empty dump truck, the truck should be loaded and the area proofrolled again. The proofroller should make at least four passes over each location, with the last two passes perpendicular to the first two.

Areas which wave, rut, or deflect excessively and continue to do so after several passes of the proofroller should be excavated to firmer soils, or biaxial geogrid may be require to help stabilize subgrade conditions. We anticipate that biaxial geogrid (Tensar BX1200 or approved equivalent) will be required for significant portions of the site supporting earthwork fills, pavements and exterior grade slabs in Area C. Excavated areas should be backfilled in thin (8-inch to 10-inch) lifts with engineered fill as recommended later in this report. The proofrolling and excavating operations should be monitored by an engineering technician working under the direction of the geotechnical engineer. Proofrolling should not be performed immediately following periods of precipitation or on wet or saturated subgrade.

The surface of the onsite soils can deteriorate and lose its support capabilities when exposed to environmental changes and construction traffic. The removal or recompaction of these surficial soils may be required prior to construction of pavements and grade slabs. The extent of removal, if necessary, should be determined during construction by proofrolling.

Groundwater and Surface Water

As previously described in the *Subsurface Conditions* section of this report, groundwater was not encountered by tests performed during this exploration in Area A or Area B. If groundwater is encountered during construction in either of these areas, especially at proposed excavations and/or cut slopes, the geotechnical engineer should be contacted immediately to develop recommendations for subsurface drainage control. Adequate control of groundwater could likely be accomplished by means of gravity ditches, French drain systems, or pumping from gravel-line cased sumps. The contractor should be prepared to promptly remove surface water from the general construction area by similar methods.

Groundwater was encountered by each of the test pits performed during this exploration in Area C, and in some cases within a few feet of proposed finished grade. We anticipate that groundwater will likely be encountered during site grading and construction in Area C. We recommend that groundwater be lowered and maintained at a depth of at least 2 feet below bearing levels and/or excavation bottoms during

construction. As noted above, dequate control of groundwater could likely be accomplished by means of gravity ditches, French drain systems, or pumping from gravel-line cased sumps. The contractor should be prepared to promptly remove surface water from the general construction area by similar methods.

Slopes and Excavations

Confined excavations such as for utility installation should conform to OSHA regulations. For slopes that are not confined, our experience suggests that permanent cut slopes through undisturbed residuum such as that encountered in Area A should be laid back at a 2H:1V (horizontal to vertical) slope, or flatter. Due to the already-marginal factor of safety for stability of the existing colluvium at the site, we do not recommend permanent or temporary cut slopes or excavations be performed in Area B without the implementation of a soil nail system as noted above. Temporary cuts through colluvium and/or alluvium encountered in Area C should be laid back at a 3H:1V (horizontal to vertical) slope, or flatter, with maximum heights not exceeding 5 feet. Permanent cut slopes through alluvium are not recommended/anticipated.

Permanent fill slopes constructed with newly placed engineered fill should be placed on a suitable foundation and should be constructed at 2H:1V, or flatter. Permanent fill slopes should not be constructed atop existing colluvium at the site. Construction of permanent fill slopes atop alluvium within Area C will require ground improvement measures as noted above in the *Area C: Grade Slabs, Pavements & Earthwork Fills* section of this report. Horizontal benches should be installed at regular vertical intervals in fill slopes as required by municipal codes. Cut and fill slope surfaces should be protected from erosion by grassing or by other means.

Permanent slopes of 3H:1V or flatter may be desirable for mowing. In general, it is recommended that the edge of fill should extend at least 5 feet horizontally beyond paved areas. The edge of fill should extend a minimum of 10 feet horizontally beyond the edge of buildings or a minimum of 1/3 the height of the fill slope, whichever is greater.

SPECIFICATIONS REVIEW

We recommend that we be retained to make a review of the foundation and earthwork plans and specifications prepared from the recommendations presented in this report. We would then suggest any modifications so that our recommendations are properly interpreted and implemented. An additional fee would apply for review of plans and specifications.

BASIS OF RECOMMENDATIONS

Our evaluation of foundation support conditions and site preparation recommendations has been based on our understanding of the project information and data obtained in our exploration as well as our experience on similar projects. The general subsurface conditions utilized in our geotechnical assessment of the site have been based on interpolation of the subsurface data between the widely spaced test pits. Subsurface conditions between the test locations will differ. If the project information is incorrect or proposed grading locations (horizontal or vertical) and/or dimensions are changed, please contact us so that our recommendations can be reviewed. The discovery of site or subsurface conditions during construction which deviate from the data obtained in this exploration should be reported to us for our evaluation. The assessment of site environmental conditions for the presence or absence of pollutants in the soil, rock and groundwater of the site was beyond the scope of this exploration.

APPENDIX

SITE LOCATION PLAN – FIGURE 1

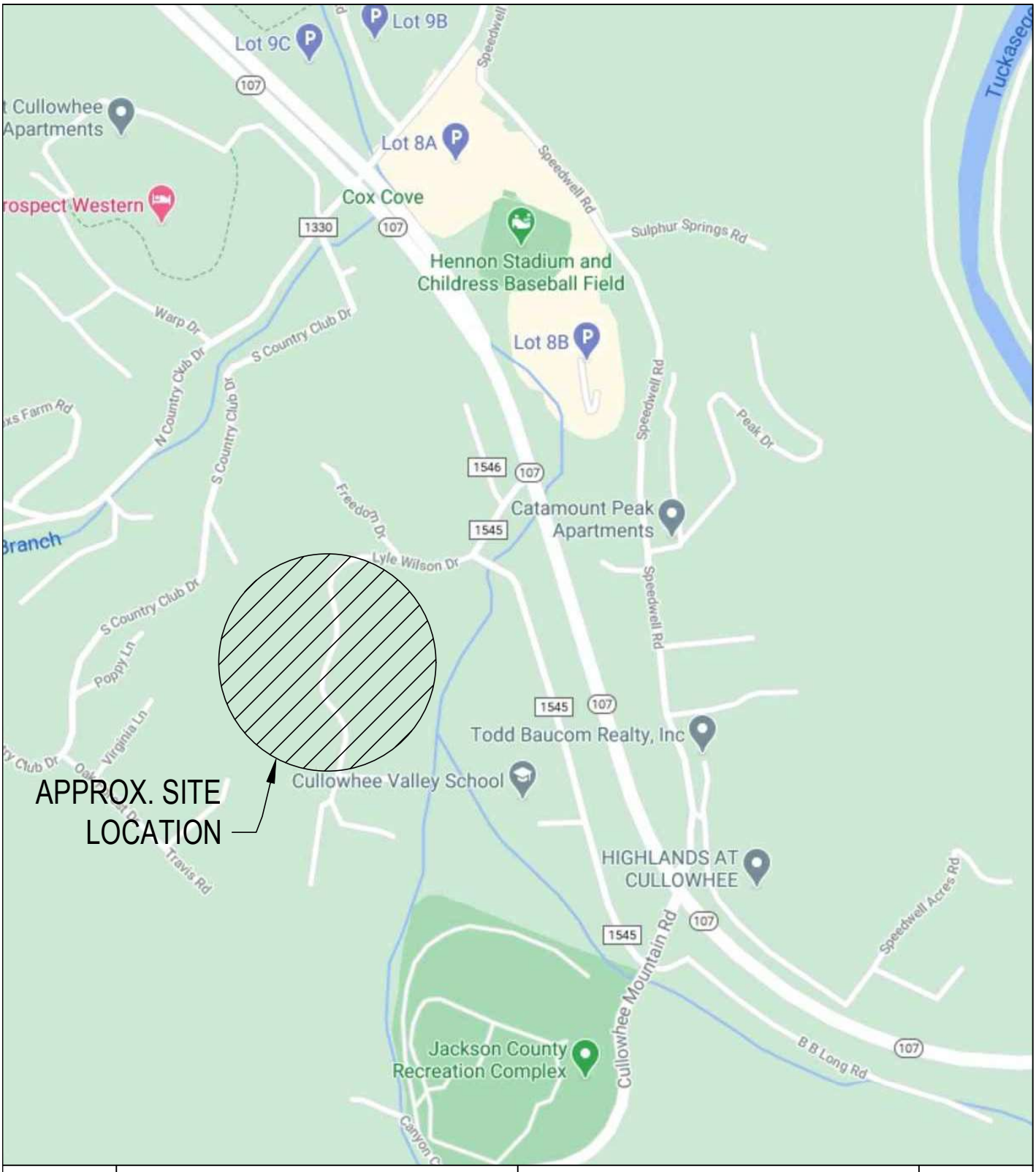
FIELD EXPLORATION PLAN – FIGURE 2

FIELD EXPLORATION AND LABORATORY TEST PROCEDURES

TEST PIT LOGS AND HAND AUGER BORING LOG (TP-1 TO TP-12, HAB-13, TP-14 TO TP-27)

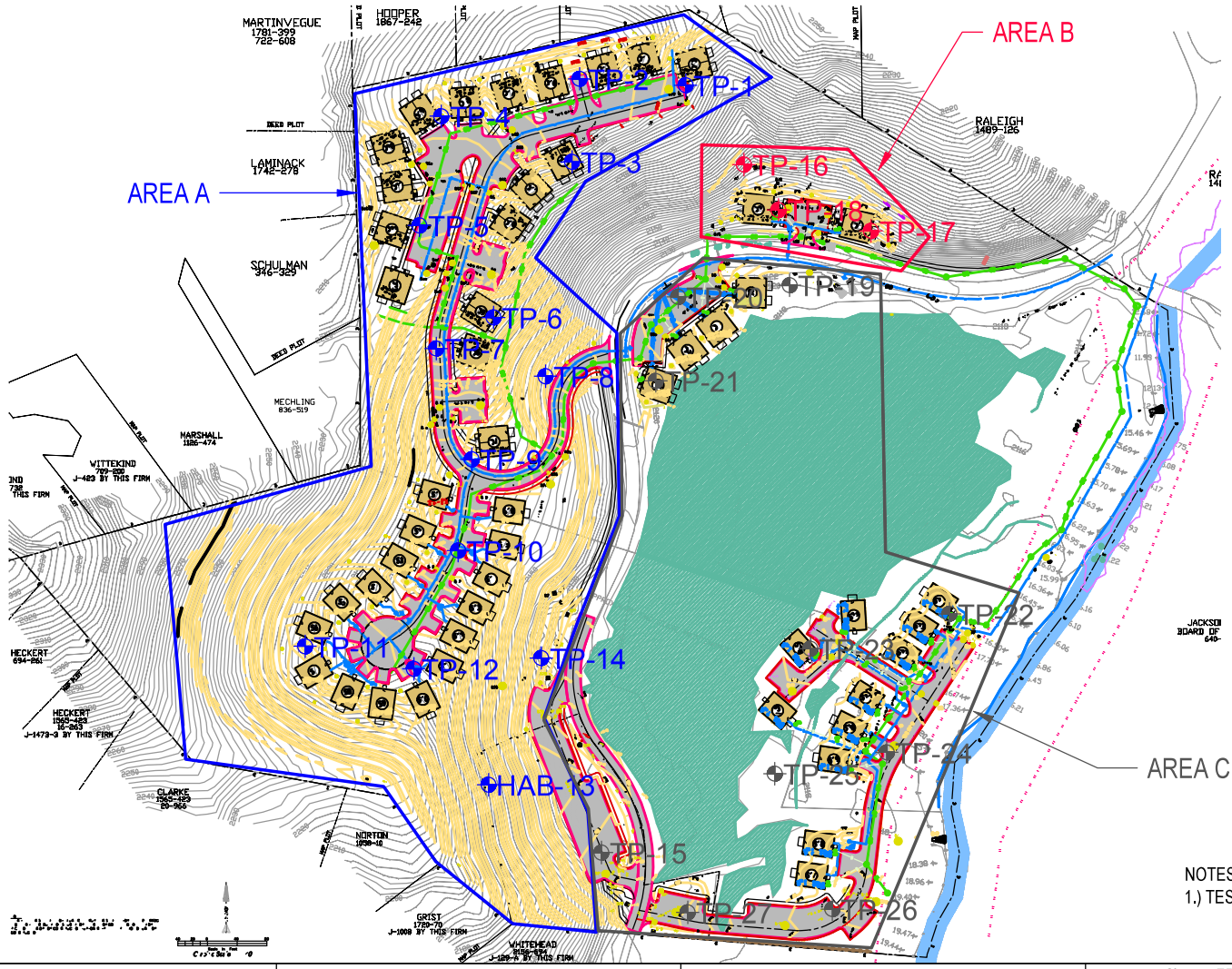
KEY TO SOIL CLASSIFICATIONS AND CONSISTENCY DESCRIPTIONS

LABORATORY TEST RESULTS



N	SITE LOCATION PLAN KEG PROJECT NO. JA20-4106-01 DATE: 02-12-2021	ELEVATE DEVELOPMENT - LYLE WILSON ROAD CULLOWHEE, NORTH CAROLINA	FIGURE 1

KESSEL ENGINEERING GROUP
582 HENDERSONVILLE ROAD SUITE ONE | ASHEVILLE NC 28803 | P:[828] 277-6351 | F:[828] 277-6355
WWW.THEKESSELGROUP.COM



NOTES:
1.) TEST LOCATIONS ARE APPROXIMATE

KESSEL ENGINEERING GROUP

ELEVATE DEVELOPMENT - LYLE WILSON ROAD
CULLOWHEE, NORTH CAROLINA
KEG PROJECT NO. JA120-4106-01

FIELD EXPLORATION PLAN DATE: 02-12-2021
REFERENCE: Land Plan for Elevate: A Planned Residential Development, by Lofquist & Associates, Inc., updated 01/15/2021

0' 75' 150' 300'
SCALE: 1" = 150'-0"

FIGURE
2

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FIELD EXPLORATION AND LABORATORY TEST PROCEDURES

TEST PITS

The test pits were excavated by a John Deere 130G excavtor and a Bobcat E35 mini-excavator. The soils encountered were identified in the field from cuttings brought to the surface by the excavation equipment. At regular intervals the soil consistency was measured with a cone penetrometer. The conical point was first seated to penetrate any loose cuttings and was then driven additional increments of 1¾ inches with blows from a 15-pound hammer falling 20 inches. The number of blows required to achieve this penetration was recorded. The penetration resistance, once properly evaluated, is an index to the soil strength. Soil descriptions and penetrometer test data are tabulated on the attached Test Pit Logs.

LABORATORY COMPACTION TESTING

Two representative samples of the residual soils were collected, placed in buckets and transported to the laboratory for compaction testing. Standard Proctor compaction testing (ASTM D 698) was performed to determine the compaction characteristics including maximum dry density and optimum moisture content. Test results are presented on the attached Compaction Test Reports and in Table 1 of the attached Report.

NATURAL MOISTURE CONTENT

The natural moisture content of selected samples was determined in accordance with ASTM D 2216. The moisture content of the soil is the ratio, expressed as a percentage, of the weight of water in a given mass of soil to the weight of the soil particles. The results are presented in the Table 1 of the attached Report.

PERCENT FINES

The percentage of fine-grained particles present in the selected samples was determined by passing the sample through a No. 200 mesh sieve. The percent by weight passing the sieve is the percentage of fines or the portion of the sample in the silt and clay size range. These tests were conducted in accordance with ASTM D 1140. The results are shown on the lower right hand corner of the attached Compaction Test Reports and Table 1 of the attached Report.

SOIL PLASTICITY

Representative samples of the fine-grained soils were selected for Atterberg Limits testing to determine their soil plasticity characteristics. The soil's Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). These characteristics are determined in accordance with ASTM D 4318. The LL is the moisture content at which the soil will flow as a heavy viscous fluid. The PL is the moisture content at which the soil begins to lose its plasticity. The data obtained are presented on the attached Liquid and Plastic Limit Test Reports. The results are presented in the Table 1 of the attached Report.

TEST PIT NO. TP-1

KESSEL ENGINEERING GROUP

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-21-20 END: 10-21-20

LOCATION: See Figure 2 | ELEVATION: 2228 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: I. Johnson

EXCAVATION EQUIPMENT: John Deere 130G

DEPTH TO - WATER> INITIAL▽ _____ AFTER 24 HOURS:▼ _____ CAVING>▨ _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Very Loose, Reddish Brown, Silty, Fine to Medium SAND with Rock Fragments (Colluvium)		3 2 3	n = 2
2225	Very Loose to Loose, Brownish Orange to Reddish Brown with Black, Silty, Fine to Coarse SAND with Rock Fragments (Residuum)		4 3 5	n = 4
5			8 8 8	n = 8
	Very Firm, Brown with Pink, Silty, Fine to Coarse SAND with Partially Weathered Rock Fragments		18 20 25/1	n = 25/1
2220			24 25/1	n = 25/1
10				
	Equipment refusal encountered at 11.0 feet. No groundwater encountered at time of excavation.			
2215				
15				
2210				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

SOIL TEST BORING REVISED 4106-01 ELEVATE DEVELOPMENT.GPJ KESSEL GROUP.GDT 2/3/21

TEST PIT NO. TP-2

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-21-20 END: 10-21-20

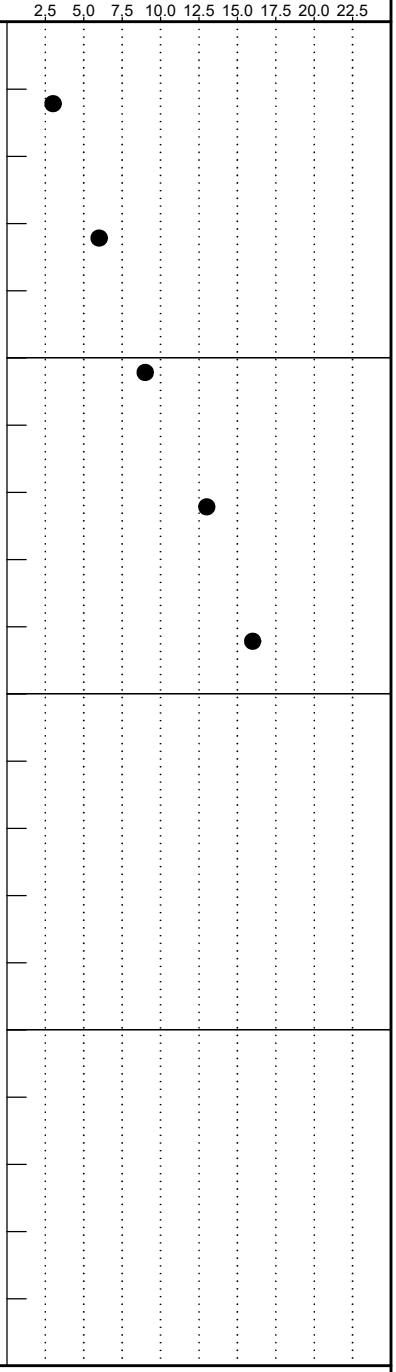
LOCATION: See Figure 2 | ELEVATION: 2270 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: I. Johnson

EXCAVATION EQUIPMENT: John Deere 130G

DEPTH TO - WATER> INITIAL: _____ AFTER 24 HOURS: _____ CAVING> _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Very Loose, Reddish Brown, Silty, Fine to Medium SAND (Residuum)		3 4 3	n = 3
	Loose, Black with Brown, Very Slightly Micaceous, Silty, Fine to Coarse SAND with Trace Gravel		5 6 6	n = 6
2265 — 5			7 9 10	n = 9
			12 12 14	n = 13
	Firm, Pink with Tan, Very Slightly Micaceous, Silty, Fine to Coarse SAND		14 17 16	n = 16
2260 — 10				
2255 — 15				
	Test pit terminated at 19.0 feet. No groundwater encountered at time of excavation.			



KESSEL ENGINEERING GROUP

TEST PIT NO. TP-3

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-20-20 END: 10-20-20

LOCATION: See Figure 2 | ELEVATION: 2230 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: I. Johnson

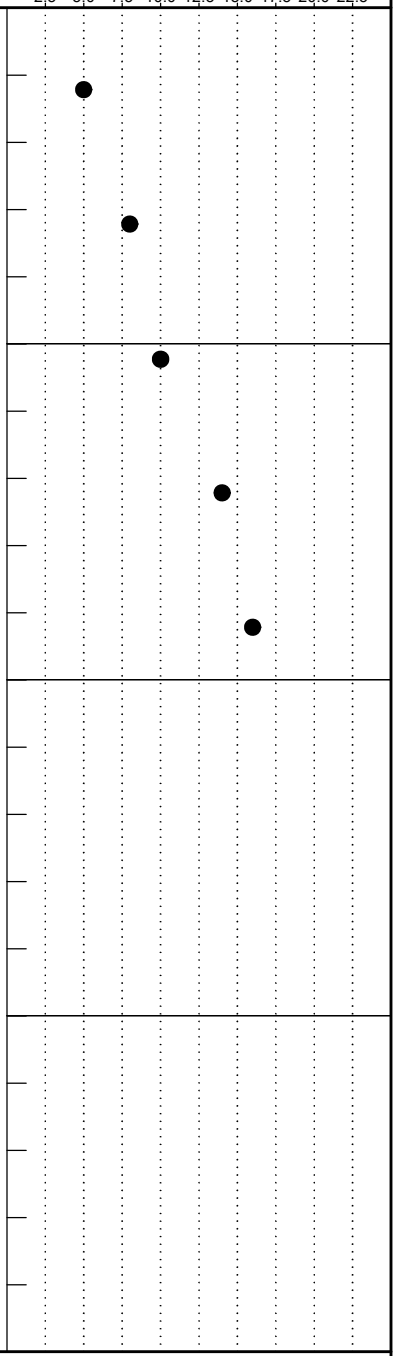
EXCAVATION EQUIPMENT: John Deere 130G

DEPTH TO - WATER> INITIAL▽ _____ AFTER 24 HOURS:▼ _____ CAVING>▨ _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Loose, Brown, Silty, Fine to Medium SAND with Rock Fragments (Colluvium)		5 5 6	n = 5
			6 8 9	n = 8
	Loose, Orangish Red, Silty, Fine to Coarse SAND (Residuum)			
2225 — 5			11 11 10	n = 10
			13 13 16	n = 14
	Firm, Orange with Black and Red, Silty, Fine to Medium SAND		13 15 18	n = 16
2220 — 10				
	Test pit terminated at 14.0 feet. No groundwater encountered at time of excavation.			
2215 — 15				

DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5



TEST PIT NO. TP-3
Sheet 1 of 1

SOIL TEST BORING REVISED 4106-01 ELEVATE DEVELOPMENT.GPJ KESSEL GROUP.GDT 2/3/21

TEST PIT NO. TP-4

KESSEL ENGINEERING GROUP

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-20-20 END: 10-20-20

LOCATION: See Figure 2 | ELEVATION: 2244 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: I. Johnson

EXCAVATION EQUIPMENT: John Deere 130G

DEPTH TO - WATER> INITIAL: ____ AFTER 24 HOURS: ____ CAVING> ____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Reddish Brown, Slightly Moist, Sandy SILT (Residuum)		5 4 5	n = 4
	Loose, Reddish Brown, Silty, Fine to Coarse SAND with Rock Fragments		6 8 8	n = 8
2240				
5			7 10 14	n = 12
	Firm to Very Firm, Reddish Brown, Silty, Fine to Medium SAND with Partially Weathered Rock Fragments		18 22 23	n = 22
2235			25/1	n = 25/1
10				
2230	Test pit terminated at 14.0 feet. No groundwater encountered at time of excavation.			
15				
2225				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

SOIL TEST BORING REVISED 4106-01 ELEVATE DEVELOPMENT.GPJ KESSEL GROUP.GDT 2/3/21

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-5

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-20-20 END: 10-20-20

LOCATION: See Figure 2 | ELEVATION: 2226 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: I. Johnson

EXCAVATION EQUIPMENT: John Deere 130G

DEPTH TO - WATER> INITIAL: _____ AFTER 24 HOURS: _____ CAVING> _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
2225	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Firm to Stiff, Reddish Brown, Sandy SILT (Residuum)		4 5 6	n = 5
			7 10 10	n = 10
5			8 10 12	n = 11
2220			13 16 15	n = 15
	Firm, Reddish Brown with Tan, Slightly Micaceous, Silty, Fine to Medium SAND		13 17 17	n = 17
10				
2215				
	Test pit terminated at 14.0 feet. No groundwater encountered at time of excavation.			
15				
2210				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-6

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-20-20 END: 10-20-20

LOCATION: See Figure 2 | ELEVATION: 2200 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: I. Johnson

EXCAVATION EQUIPMENT: John Deere 130G

DEPTH TO - WATER> INITIAL: _____ AFTER 24 HOURS: _____ CAVING> _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES		DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
					2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5
	Approximately 1 Foot TOPSOIL and/or ROOTMAT				
	Very Loose to Loose, Reddish Brown, Silty, Fine SAND (Colluvium)			3 3 3	n = 3
	Loose, Reddish Brown, Very Slightly Micaceous, Silty, Fine SAND (Residuum)			6 7 9	n = 8
	Firm, Brown and Reddish Brown, Silty, Fine to Medium SAND			13 15 18	n = 16
2195 — 5				17 18 24	n = 21
				12 13 13	n = 13
2190 — 10					
	Test pit terminated at 14.0 feet. No groundwater encountered at time of excavation.				
2185 — 15					

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-7

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-20-20 END: 10-20-20

LOCATION: See Figure 2 | ELEVATION: 2204 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: I. Johnson

EXCAVATION EQUIPMENT: John Deere 130G

DEPTH TO - WATER> INITIAL: _____ AFTER 24 HOURS: _____ CAVING> _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Dark Reddish Brown, Sandy SILT (Colluvium)		4 4 4	n = 4
	Stiff, Dark Reddish Brown, Sandy SILT (Residuum)		7 12 12	n = 12
2200				
5			10 10 12	n = 11
	Firm, Light Reddish Brown, Silty, Fine SAND		15 17 18	n = 17
2195			16 18 18	n = 18
10				
2190	Test pit terminated at 14.0 feet. No groundwater encountered at time of excavation.			
15				
2185				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-8

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-20-20 END: 10-20-20

LOCATION: See Figure 2 | ELEVATION: 2156 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: I. Johnson

EXCAVATION EQUIPMENT: John Deere 130G

DEPTH TO - WATER> INITIAL▽ _____ AFTER 24 HOURS:▼ _____ CAVING>▨ _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
2155	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Very Loose, Brown, Slightly Moist, Silty, Fine SAND (Colluvium)		3 4 4	n = 4
	Loose, Brown with Black, Silty, Fine to Coarse SAND with Partially Weathered Rock Fragments (Residuum)		5 6 6	n = 6
5	Very Firm, Reddish Brown with Black and White, Silty, Fine to Coarse SAND with Partially Weathered Rock Fragments		22 25/1	n = 25/1
2150	Firm, Reddish Brown with White, Silty, Fine to Coarse SAND		14 18 19	n = 18
			17 17 18	n = 17
10				
2145				
	Test pit terminated at 14.0 feet. No groundwater encountered at time of excavation.			
15				
2140				

DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches: 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-9

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-21-20 END: 10-21-20

LOCATION: See Figure 2 | ELEVATION: 2173 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: I. Johnson

EXCAVATION EQUIPMENT: John Deere 130G

DEPTH TO - WATER> INITIAL: _____ AFTER 24 HOURS: _____ CAVING> _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Dark Brown, Sandy SILT (Colluvium)		3 3 3	n = 3
2170	Firm to Stiff, Reddish Brown, Very Slightly Micaceous, Sandy SILT (Residuum)		4 6 5	n = 5
5			7 7 8	n = 7
			7 8 9	n = 8
2165			10 11 13	n = 12
10				
2160	Red with Tan, Silty, Fine to Coarse SAND with Trace Gravel			
	Test pit terminated at 14.0 feet. No groundwater encountered at time of excavation.			
15				
2155				

DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches: 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-10

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-21-20 END: 10-21-20

LOCATION: See Figure 2 | ELEVATION: 2168 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: John Deere 130G

DEPTH TO - WATER> INITIAL: ▽ | AFTER 24 HOURS: ▼ | CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Dark Reddish Brown, Sandy SILT (Colluvium)		4 4 5	n = 4
2165	Firm, Reddish Brown, Sandy SILT (Residuum)		5 6 5	n = 5
5			6 7 8	n = 7
	Stiff, Reddish Brown, Sandy SILT with Trace Rock Fragments		10 11 13	n = 12
2160	Stiff, Reddish Brown and Black, Slighly Micaceous, Sandy SILT		13 15 16	n = 15
10				
2155				
	Test pit terminated at 14.0 feet. No groundwater encountered at time of excavation.			
15				
2150				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

TEST PIT NO. TP-11

KESSEL ENGINEERING GROUP

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-21-20 END: 10-21-20

LOCATION: See Figure 2 | ELEVATION: 2200 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: John Deere 130G

DEPTH TO - WATER> INITIAL: ____ AFTER 24 HOURS: ____ CAVING> ____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Reddish Brown, Sandy SILT (Colluvium)		3 3 4	n = 3
			4 4 4	n = 4
	Firm, Reddish Brown, Sandy SILT with Trace Cobble (Colluvium)			
2195 — 5			6 9 9	n = 9
	Stiff, Reddish Brown, Sandy SILT (Residuum)		8 9 11	n = 10
			12 15 14	n = 14
2190 — 10				
	Test pit terminated at 14.0 feet. No groundwater encountered at time of excavation.			
2185 — 15				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-12

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-21-20 END: 10-21-20

LOCATION: See Figure 2 | ELEVATION: 2194 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: John Deere 130G

DEPTH TO - WATER> INITIAL: _____ AFTER 24 HOURS: _____ CAVING> _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Reddish Brown, Sandy SILT (Colluvium)		3 3 3	n = 3
	Loose, Reddish Brown and Black, Silty, Fine to Medium SAND (Residuum)		4 4 6	n = 5
2190 / 5			6 8 9	n = 8
			10 10 11	n = 10
2185 / 10			13 13 15	n = 14
2180 / 15	Test pit terminated at 14.0 feet. No groundwater encountered at time of excavation.			
2175				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

HAND AUGER BORING NO. HAB-13

PROJECT: Elevate Development **PROJECT NO.:** JA20-4106-01

CLIENT: University Property Group, LLC **DATE START:** 10-23-20 **END:** 10-23-20

LOCATION: See Figure 2 **ELEVATION:** 2165 (feet)

PERFORMED BY: KEG Representatives **LOGGED BY:** C. King

DRILLING EQUIPMENT: Hand Auger

DEPTH TO - WATER> INITIAL: ▽ _____ **AFTER 24 HOURS:** ▼ _____ **CAVING>** _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Firm, Light Red, Sandy SILT with Trace Roots (Colluvium)		4 5 5	n = 5
			4 5 7	n = 6
	Loose, Light Brown, Silty, Fine SAND (Residuum)		6 7 7	n = 7
2160 — 5			8 9 9	n = 9
	Hand auger refusal encountered at 8.0 feet. No groundwater encountered at time of excavation.			
2155 — 10				
2150 — 15				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-14

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-21-20 END: 10-21-20

LOCATION: See Figure 2 | ELEVATION: 2135 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: John Deere 130G

DEPTH TO - WATER> INITIAL: ____ AFTER 24 HOURS: ____ CAVING> ____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Reddish Brown, Sandy SILT (Colluvium)		4 5 4	n = 4
	Firm, Reddish Brown, Sandy SILT with Trace Roots (Residuum)		6 6 7	n = 6
	Loose, Red, Black and White, Slightly Micaceous, Silty, Fine SAND (Residuum)		6 10 9	n = 9
2130 — 5			12 12 13	n = 12
			12 13 13	n = 13
2125 — 10				
	Test pit terminated at 14.0 feet. No groundwater encountered at time of excavation.			
2120 — 15				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-15

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-22-20 END: 10-22-20

LOCATION: See Figure 2 | ELEVATION: 2122 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: Bobcat E35 Mini

DEPTH TO - WATER> INITIAL: 2.5 ft AFTER 24 HOURS: CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
2120	Soft, Dark Reddish Brown, Moist, Sandy SILT with Trace Fingerling Roots and Trace Cobbles (Colluvium)		3 4 4	n = 4
	Soft, Dark Brown and Dark Gray, Wet, Sandy SILT with Fingerling Roots (Alluvium)		3 3 3	n = 3
5			2 3 4	n = 3
	Equipment refusal encountered at 6.0 feet. Groundwater encountered at 2.5 feet at time of excavation.			
2115				
10				
2110				
15				
2105				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

Note: Refusal due to pit collapsing.

TEST PIT NO. TP-15
Sheet 1 of 1

SOIL TEST BORING REVISED 4106-01 ELEVATE DEVELOPMENT.GPJ KESSEL GROUP.GDT 2/3/21

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-16

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-22-20 END: 10-22-20

LOCATION: See Figure 2 | ELEVATION: 2168 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: Bobcat E35 Mini

DEPTH TO - WATER> INITIAL▽ _____ AFTER 24 HOURS:▼ _____ CAVING>▨ _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft to Firm, Dark Reddish Brown, Moist, Sandy SILT (Colluvium)		2 2 2	n = 2
2165			3 4 4	n = 4
5			4 6 6	n = 6
	Firm to Stiff, Dark Reddish Brown, Moist, Slightly Clayey, Sandy SILT with Trace Cobbles (Colluvium)		6 8 10	n = 9
2160				
	Test pit terminated at 9.0 feet. No groundwater encountered at time of excavation.		9 9 11	n = 10
10				
2155				
15				
2150				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-17

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-22-20 END: 10-22-20

LOCATION: See Figure 2 | ELEVATION: 2140 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: Bobcat E35 Mini

DEPTH TO - WATER> INITIAL: _____ AFTER 24 HOURS: _____ CAVING> _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Dark Reddish Brown, Sandy SILT (Colluvium)		2 2 2	n = 2
			2 3 4	n = 3
2135 — 5			4 3 5	n = 4
	Firm, Dark Reddish Brown, Sandy SILT (Colluvium)		4 6 6	n = 6
	Test pit terminated at 9.0 feet. No groundwater encountered at time of excavation.		6 7 8	n = 7
2130 — 10				
2125 — 15				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-18

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-22-20 END: 10-22-20

LOCATION: See Figure 2 | ELEVATION: 2140 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: Bobcat E35 Mini

DEPTH TO - WATER> INITIAL▽ _____ AFTER 24 HOURS:▼ _____ CAVING>▨ _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Dark Reddish Brown, Sandy SILT (Colluvium)		2 2 3	n = 2
			3 3 4	n = 3
	Firm, Dark Reddish Brown, Sandy SILT with Trace Cobbles (Colluvium)			
2135 — 5			4 5 7	n = 6
			5 7 7	n = 7
	Firm, Dark Reddish Brown, Sandy SILT with Trace Fingerling Roots (Colluvium)			
	Test pit terminated at 9.0 feet. No groundwater encountered at time of excavation.		6 8 8	n = 8
2130 — 10				
2125 — 15				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

SOIL TEST BORING REVISED 4106-01 ELEVATE DEVELOPMENT.GPJ KESSEL GROUP.GDT 2/3/21

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-19

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-22-20 END: 10-22-20

LOCATION: See Figure 2 | ELEVATION: 2120 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: Bobcat E35 Mini

DEPTH TO - WATER> INITIAL: 5 ft AFTER 24 HOURS: CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Dark Reddish Brown, Sandy SILT with Trace Fingerling Roots (Colluvium)		4 4 5	n = 4
	Soft, Reddish Brown and Gray, Sandy SILT with Trace Fingerling Roots (Colluvium)		3 3 3	n = 3
2115 — 5			2 3 3	n = 3
	Soft, Gray, Slightly Micaceous, Wet, Lean CLAY (Alluvium)		3 4 4	n = 4
	Loose, Brown and Gray, Micaceous, Wet, Silty SAND (Residuum)		4 5 5	n = 5
	Test pit terminated at 9.0 feet. Groundwater encountered at 5 feet at time of excavation.			
2110 — 10				
2105 — 15				

DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-20

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-22-20 END: 10-22-20

LOCATION: See Figure 2 | ELEVATION: 2122 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: Bobcat E35 Mini

DEPTH TO - WATER> INITIAL: 7 ft AFTER 24 HOURS: CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
2120	Soft, Dark Reddish Brown, Sandy SILT with Trace Fingerling Roots (Colluvium)		3 4 4	n = 4
			3 4 4	n = 4
	Soft, Reddish Brown and Gray, Slightly Micaceous, Moist, Sandy SILT (Alluvium)			
5			3 3 3	n = 3
2115				
	Brown, Tan and Gray, Very Micaceous, Wet, Silty, Fine to Medium SAND (Residuum)			
	Test pit terminated at 9.0 feet. Groundwater encountered at 7 feet at time of excavation.			
10				
2110				
15				
2105				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

SOIL TEST BORING REVISED 4106-01 ELEVATE DEVELOPMENT.GPJ KESSEL GROUP.GDT 2/3/21

TEST PIT NO. TP-21

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-22-20 END: 10-22-20

LOCATION: See Figure 2 | ELEVATION: 2120 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: Bobcat E35 Mini

DEPTH TO - WATER> INITIAL: 3 ft AFTER 24 HOURS: CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Dark Reddish Brown, Sandy SILT (Colluvium)		4 4 4	n = 4
	Very Loose, Dark Gray, Slightly Micaceous, Moist, Silty, Fine SAND (Alluvium)		3 4 4	n = 4
2115 — 5			3 3 4	n = 3
			4 4 4	n = 4
	Test pit terminated at 9.0 feet. Groundwater encountered at 3 feet at time of excavation.		4 5 4	n = 4
2110 — 10				
2105 — 15				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

TEST PIT NO. TP-21
Sheet 1 of 1

SOIL TEST BORING REVISED 4106-01 ELEVATE DEVELOPMENT.GPJ KESSEL GROUP.GDT 2/3/21

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-22

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-22-20 END: 10-22-20

LOCATION: See Figure 2 | ELEVATION: 2120 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: Bobcat E35 Mini

DEPTH TO - WATER> INITIAL: 4.5 ft AFTER 24 HOURS: _____ CAVING> _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft to Firm, Dark Reddish Brown, Slightly Micaceous, Moist, Sandy SILT with Fingerling Roots (Alluvium)		4 4 4	n = 4
			4 5 5	n = 5
	Firm, Gray and Brown, Micaceous, Wet, Silty, Fine SAND (Alluvium)			
2115 — 5			5 5 5	n = 5
	Firm, Dark Reddish Brown, Wet, Sandy SILT with Trace Fingerling Roots and with Cobbles at 7 feet (Alluvium)		4 5 6	n = 5
	Test pit terminated at 9.0 feet. Groundwater encountered at 4.5 feet at time of excavation.		5 6 5	n = 5
2110 — 10				
2105 — 15				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

SOIL TEST BORING REVISED 4106-01 ELEVATE DEVELOPMENT.GPJ KESSEL GROUP.GDT 2/3/21

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-23

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-23-20 END: 10-23-20

LOCATION: See Figure 2 | ELEVATION: 2120 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: Bobcat E35 Mini

DEPTH TO - WATER> INITIAL: 2 ft AFTER 24 HOURS: CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Reddish Brown and Gray, Moist, Sandy SILT with Trace Small Roots (Alluvium)		3 4 4	n = 4
	Soft, Reddish Brown and Gray, Slightly Micaceous, Moist, Sandy SILT with Fingerling Roots (Alluvium)		4 4 4	n = 4
	Very Loose, Gray, Very Micaceous, Wet, Silty, Fine to Medium SAND (Alluvium)		4 5 4	n = 4
2115 — 5	Loose, Gray, Very Micaceous, Wet, Silty, Fine to Medium SAND with Trace Topsoil, with Trace Leaf Matter and with Trace Fingerling Roots (Alluvium)		4 5 5	n = 5
	Test pit terminated at 9.0 feet. Groundwater encountered at 2 feet at time of excavation.		5 5 5	n = 5
2110 — 10				
2105 — 15				

DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches: 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

SOIL TEST BORING REVISED 4106-01 ELEVATE DEVELOPMENT.GPJ KESSEL GROUP.GDT 2/3/21

KESSEL ENGINEERING GROUP

TEST PIT NO. TP-24

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-23-20 END: 10-23-20

LOCATION: See Figure 2 | ELEVATION: 2120 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: Bobcat E35 Mini

DEPTH TO - WATER> INITIAL: 3 ft AFTER 24 HOURS: _____ CAVING> _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Dark Reddish Brown, Slightly Micaceous, Moist, Sandy SILT (Alluvium)		4 4 5	n = 4
	Very Loose, Brown, Micaceous, Wet, Silty, Fine to Medium SAND (Alluvium)		4 4 4	n = 4
2115 — 5	Very Loose, Orangish Brown, Wet, Silty, Fine to Coarse SAND with Trace Gravel (Alluvium)		3 4 4	n = 4
	Dark Brown and Gray, Slightly Micaceous, Wet, Silty, Fine to Medium SAND with Trace Rounded Gravel, with Trace Fingerling Roots and with Cobbles at 7 feet (Alluvium)			
	Equipment refusal encountered at 7.0 feet. Groundwater encountered at 3 feet at time of excavation.			
2110 — 10				
2105 — 15				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

Note: Refusal due to pit collapsing.

TEST PIT NO. TP-24
Sheet 1 of 1

SOIL TEST BORING REVISED 4106-01 ELEVATE DEVELOPMENT.GPJ KESSEL GROUP.GDT 2/3/21

TEST PIT NO. TP-25

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-25-20 END: 10-25-20

LOCATION: See Figure 2 | ELEVATION: 2120 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: Bobcat E35 Mini

DEPTH TO - WATER> INITIAL: 1.5 ft AFTER 24 HOURS: _____ CAVING>: _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Dark Gray, Moist, Sandy SILT with Fingerling Roots and with Trace Topsoil (Alluvium)		2 2 2	n = 2
	Soft, Brown, Slightly Micaceous, Moist, Sandy SILT (Alluvium)		3 3 4	n = 3
2115 — 5	Very Loose, Dark Gray, Micaceous, Wet, Silty, Fine to Medium SAND with Fingerling Roots (Alluvium)		3 4 3	n = 3
	Equipment refusal encountered at 6.0 feet. Groundwater encountered at 1.5 feet at time of excavation.			
2110 — 10				
2105 — 15				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

Note: Refusal due to pit collapsing.

TEST PIT NO. TP-25
Sheet 1 of 1

SOIL TEST BORING REVISED 4106-01 ELEVATE DEVELOPMENT.GPJ KESSEL GROUP.GDT 2/3/21

TEST PIT NO. TP-26

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-25-20 END: 10-25-20

LOCATION: See Figure 2 | ELEVATION: 2120 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: Bobcat E35 Mini

DEPTH TO - WATER> INITIAL: 4 ft AFTER 24 HOURS: CAVING>

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Dark Brown and Dark Gray, Slightly Micaceous, Moist, Sandy SILT with Trace Fingerling Roots (Alluvium)		3 3 3	n = 3
	Very Loose, Brown, Micaceous, Moist, Silty, Fine SAND with Trace Fingerling Roots (Alluvium)		3 4 3	n = 3
	Soft, Gray and Brown, Micaceous, Wet, Sandy SILT with Cobbles at 5 feet (Alluvium)			
2115 — 5			3 4 4	n = 4
	Equipment refusal encountered at 6.0 feet. Groundwater encountered at 4 feet at time of excavation.			
2110 — 10				
2105 — 15				

2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

Note: Refusal due to pit collapsing.

TEST PIT NO. TP-26
Sheet 1 of 1

SOIL TEST BORING REVISED 4106-01 ELEVATE DEVELOPMENT.GPJ KESSEL GROUP.GDT 2/3/21

TEST PIT NO. TP-27

PROJECT: Elevate Development | PROJECT NO.: JA20-4106-01

CLIENT: University Property Group, LLC | DATE START: 10-25-20 END: 10-25-20

LOCATION: See Figure 2 | ELEVATION: 2120 (feet)

EXCAVATED BY: Scott Farmer Grading | LOGGED BY: C. King

EXCAVATION EQUIPMENT: Bobcat E35 Mini

DEPTH TO - WATER> INITIAL: 1.5 ft AFTER 24 HOURS: _____ CAVING> _____

ELEVATION/ DEPTH (FT)	DESCRIPTION	SOIL TYPE	SAMPLES	DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches
	Approximately 1 Foot TOPSOIL and/or ROOTMAT			
	Soft, Dark Reddish Brown, Moist, Sandy SILT (Alluvium)		2 2 3	n = 2
	Soft, Dark Brown and Dark Gray, Slightly Micaceous, Moist, Sandy SILT with Trace Topsoil (Alluvium)		2 3 3	n = 3
2115 — 5	Soft, Dark Brown and Dark Gray, Slightly Micaceous, Moist, Sandy SILT (Alluvium)		3 3 4	n = 3
	Dark Gray, Micaceous, Wet, Silty, Fine to Coarse SAND with Gravel and with Cobbles at 7 feet (Alluvium)			
	Test pit terminated at 9.0 feet. Groundwater encountered at 1.5 feet at time of excavation.			
2110 — 10				
2105 — 15				

DYNAMIC CONE PENETRATION RESULTS BLOWS/1-3/4 inches: 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5

KEY TO SOIL CLASSIFICATIONS AND CONSISTENCY DESCRIPTIONS

Cone Penetrometer Resistance Average blows over 3-1/2 in. increment SANDS	Relative Density
1 to 4	Very Loose
5 to 15	Loose
16 to 29	Firm
over 30	Very Firm

Particle Size Identification

Boulder: Greater than 300 mm
Cobble: 75 to 300 mm
Gravel:
Coarse - 19 to 75 mm
Fine - 4.75 to 19 mm
Sand:
Coarse - 2 to 75 mm
Medium - 0.425 to 2 mm
Fine - 0.075 to 0.425 mm
Silts & Clay: Less than 0.075 mm

Cone Penetrometer Resistance Average blows over 3-1/2 in. increment SILTS and CLAYS	Consistency
1 to 4	Soft
5 to 9	Firm
10 to 29	Stiff
over 30	Very Stiff

KEY TO DRILLING SYMBOLS


Grab Sample


Split Spoon Sample

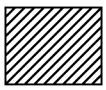

Undisturbed Sample

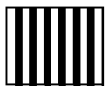

Groundwater Table at Time of Drilling

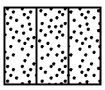

Groundwater Table 24 Hours after Completion of Drilling

KEY TO SOIL CLASSIFICATIONS

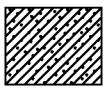

Well-graded Gravel
GW


Low Plasticity Clay
CL


Clayey Silt
MH


Silty Sand
SM


Poorly-graded Gravel
GP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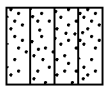
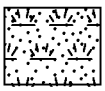
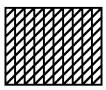

Sandy Silt
MLS


Topsoil
TOPSOIL


Partially Weathered Rock
BLDRCBBL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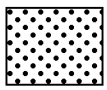
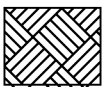
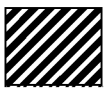
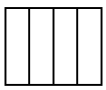
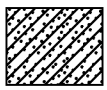
CL-ML

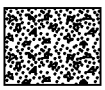

Sand
SW


Bedrock
BEDROCK

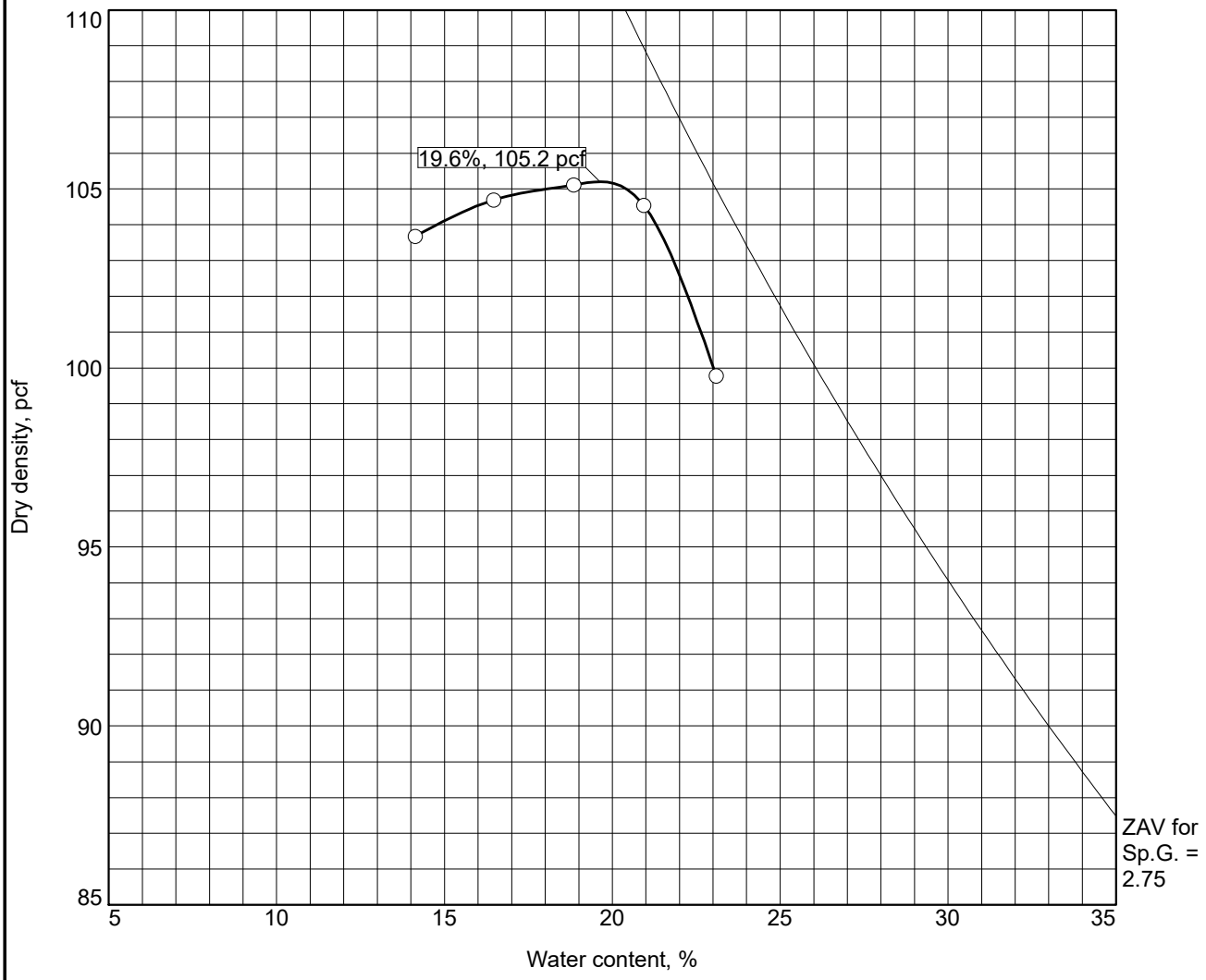

High Plasticity Clay
CH


Silt
ML


Clayey Sand
SC


Concrete
AS

COMPACTION TEST REPORT



Test specification: ASTM D 698-91 Procedure A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1' - 10'	SM	-	17.7	-	-	NP	0.9	41.1

TEST RESULTS

Maximum dry density = 105.2 pcf

Optimum moisture = 19.6 %

MATERIAL DESCRIPTION

Light Red, Silty, Fine to Coarse SAND

Project No. JA20-4106-01 **Client:** University Property Group

Project: Elevate Development

Date: 10/23/20

○ **Source of Sample:** Onsite **Sample Number:** 1

Kessel Engineering Group

Asheville, NC

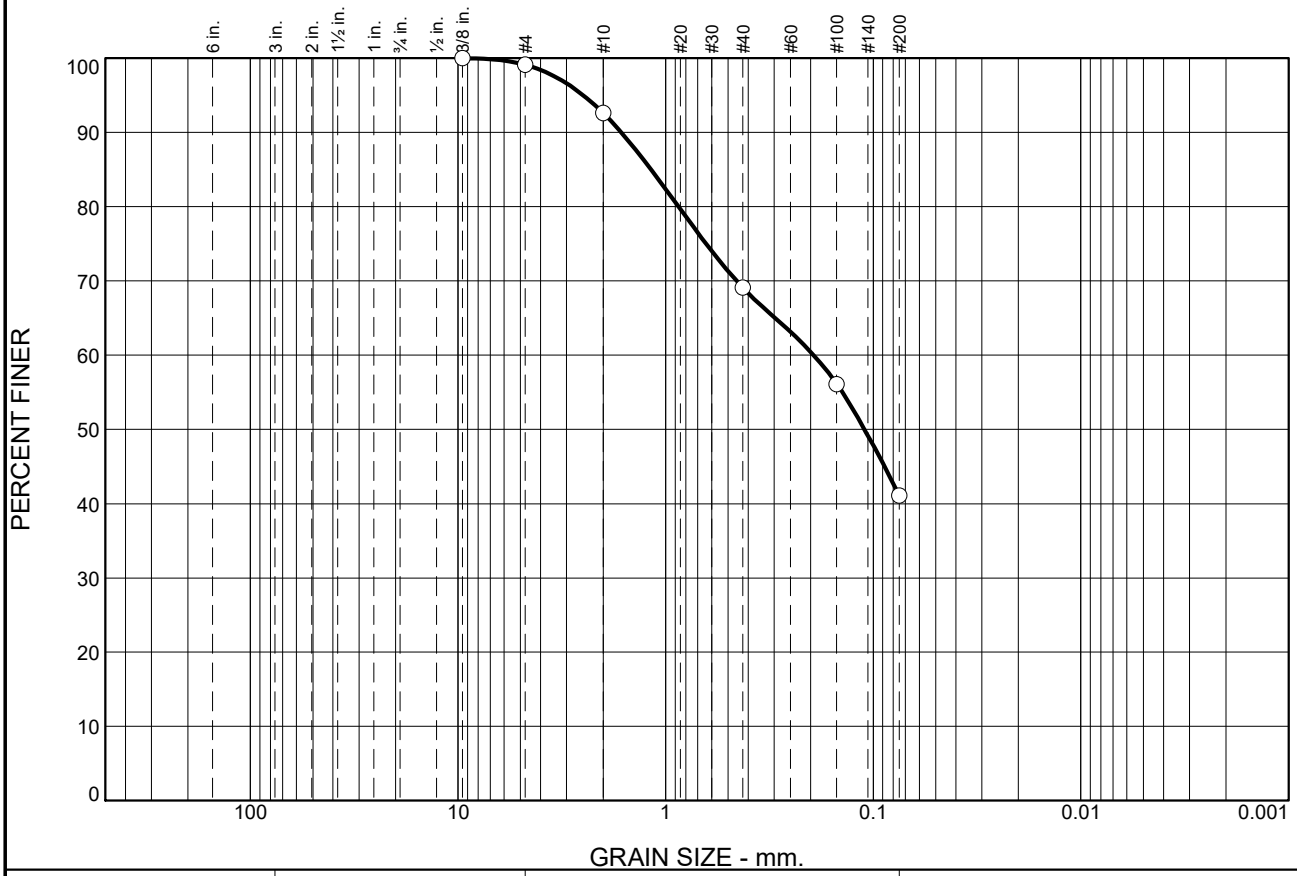
Remarks:

Standard Manual Rammer
TP-2

Figure #1A

Tested By: AT/LB **Checked By:** IJ

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.9	6.5	23.5	28.0	41.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8"	100.0		
#4	99.1		
#10	92.6		
#40	69.1		
#100	56.1		
#200	41.1		

* (no specification provided)

Material Description

Light Red, Silty, Fine to Coarse SAND

Atterberg Limits

PL= LL= - PI= NP

Coefficients

D_{90}= 1.6364 D_{85}= 1.1764 D_{60}= 0.1939
D_{50}= 0.1101 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= -

Remarks

Source of Sample: Onsite **Depth:** 1' - 10'
Sample Number: 1

Date: 10/23/20

Kessel Engineering Group

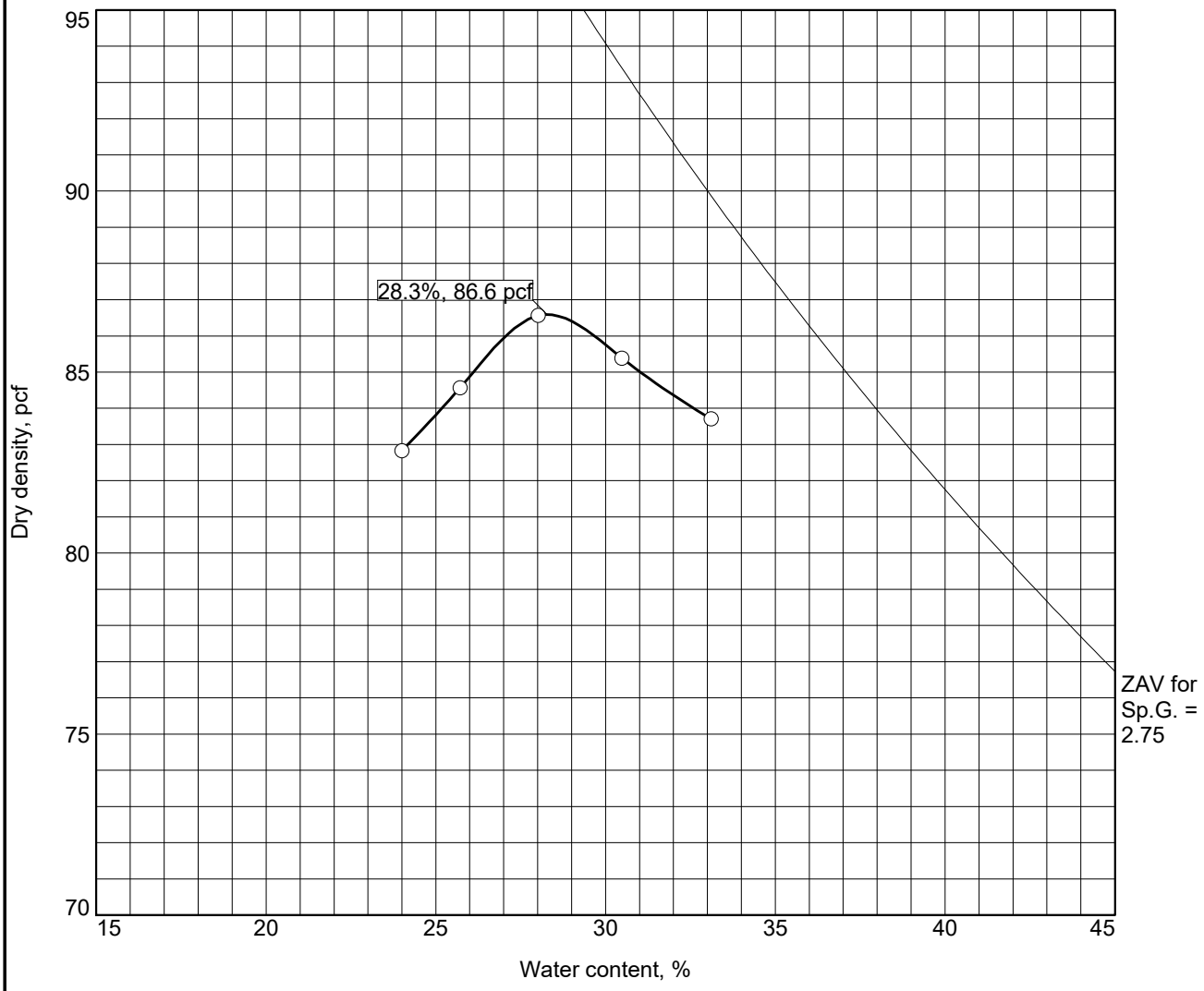
Asheville, NC

Client: University Property Group
Project: Elevate Development

Project No: JA20-4106-01 **Figure** #1B

Tested By: AT/LB **Checked By:** IJ

COMPACTION TEST REPORT



Test specification: ASTM D 698-91 Procedure A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1' - 10'	SM	-	35.1	-	-	NP	8.1	45.6

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 86.6 pcf Optimum moisture = 28.3 %	Reddish Yellow, Silty, Fine to Coarse SAND with Some Gravel

Project No. JA20-4106-01 **Client:** University Property Group

Project: Elevate Development

Date: 10/23/20

○ **Source of Sample:** Onsite **Sample Number:** 2

Kessel Engineering Group

Asheville, NC

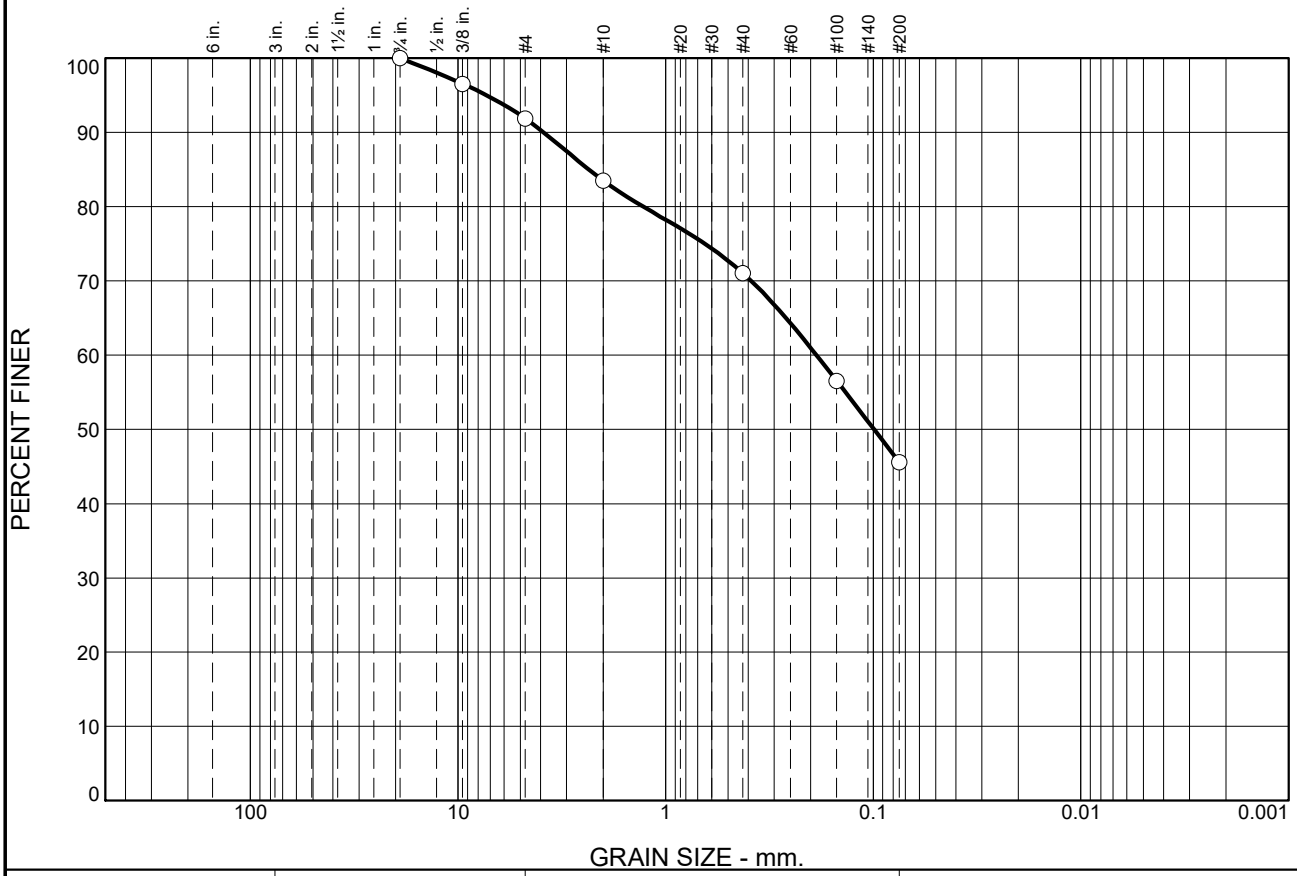
Remarks:

Standard Manual Rammer
TP-8

Figure #2A

Tested By: AT/LB **Checked By:** IJ

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.1	8.4	12.5	25.4	45.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
3/8"	96.5		
#4	91.9		
#10	83.5		
#40	71.0		
#100	56.5		
#200	45.6		

* (no specification provided)

Material Description

Reddish Yellow, Silty, Fine to Coarse SAND with Some Gravel

Atterberg Limits

PL= LL= - PI= NP

Coefficients

D_{90}= 3.8771 D_{85}= 2.3462 D_{60}= 0.1878
D_{50}= 0.0992 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= -

Remarks

Source of Sample: Onsite **Depth:** 1' - 10'
Sample Number: 2

Date: 10/23/20

Kessel Engineering Group

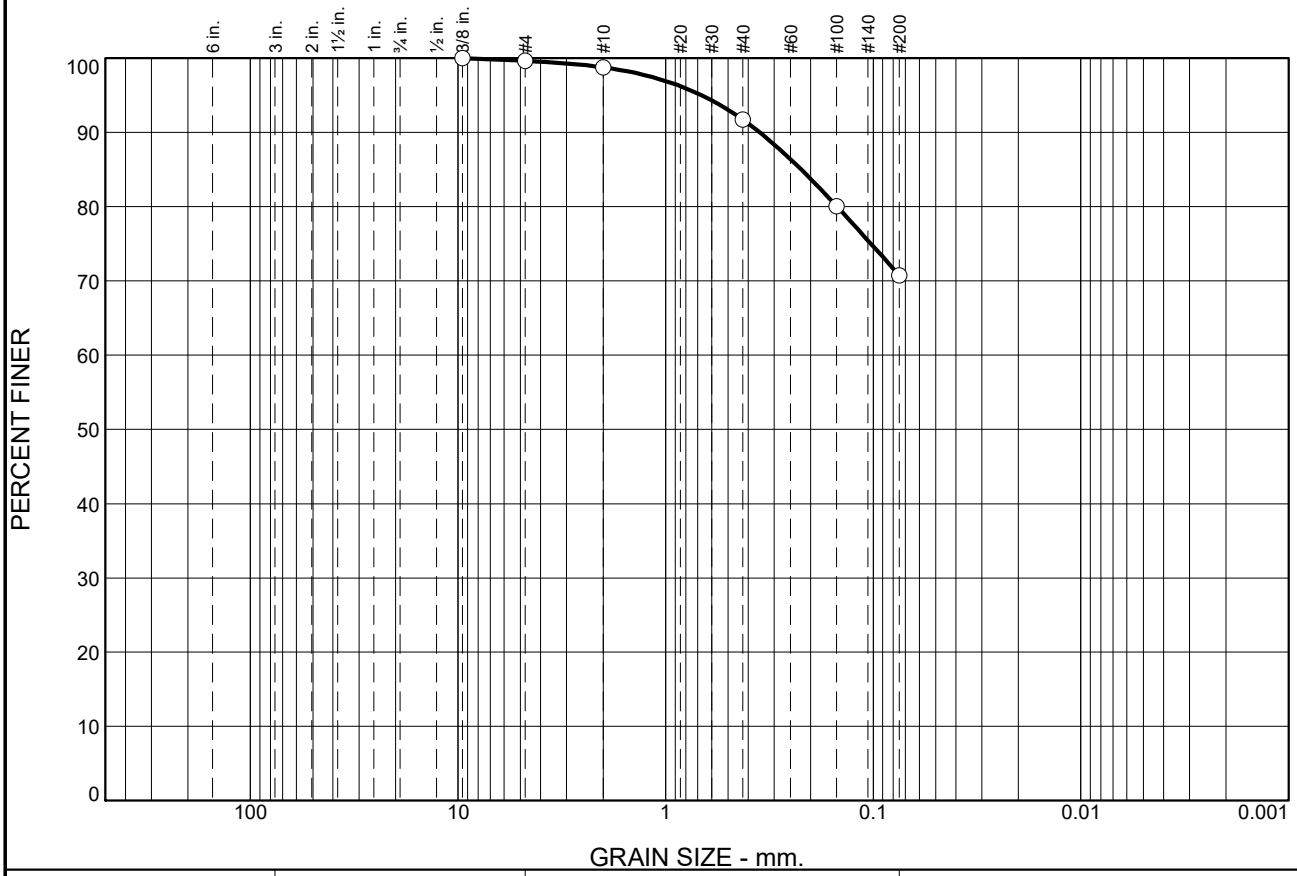
Asheville, NC

Client: University Property Group
Project: Elevate Development

Project No: JA20-4106-01 **Figure** #2B

Tested By: AT/LB **Checked By:** IJ

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.4	0.8	7.1	21.0	70.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8"	100.0		
#4	99.6		
#10	98.8		
#40	91.7		
#100	80.1		
#200	70.7		

* (no specification provided)

Material Description

Reddish Brown, Sandy SILT

Atterberg Limits

PL= 39 LL= 46 PI= 7

Coefficients

D_{90}= 0.3516 D_{85}= 0.2226 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-5(7)

Remarks

TP-19 at -5 Feet

Source of Sample: Onsite
Sample Number: 3

Date: 1/20/21

Kessel Engineering Group

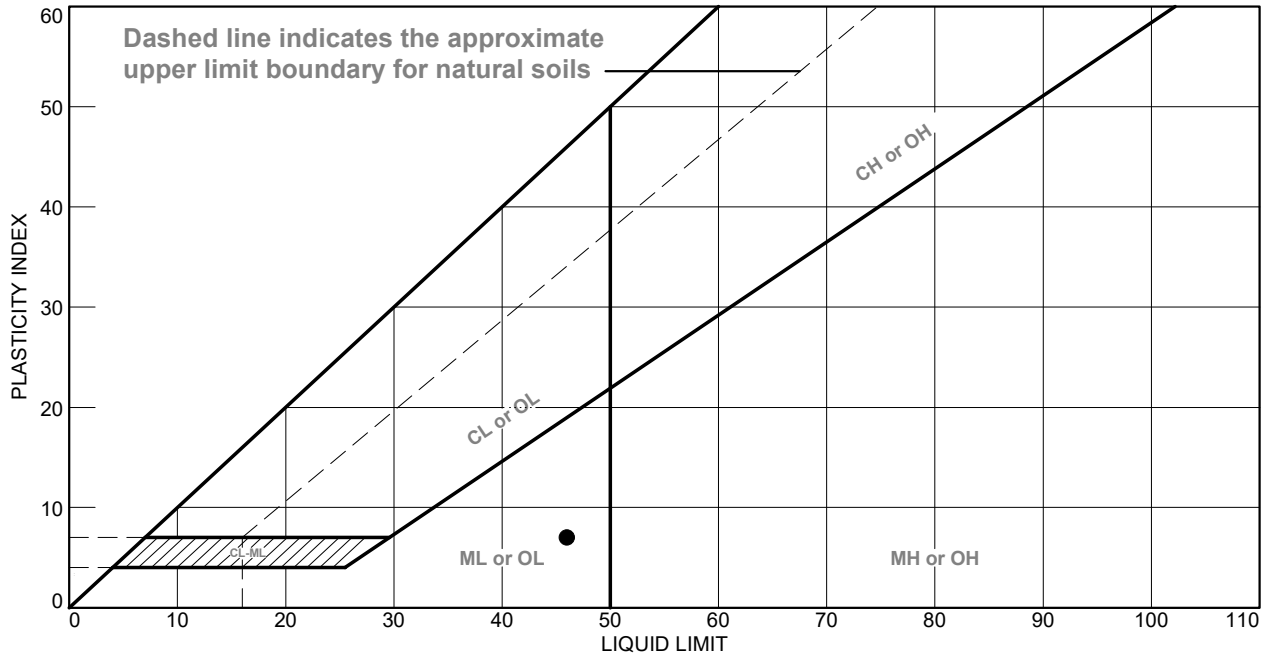
Asheville, NC

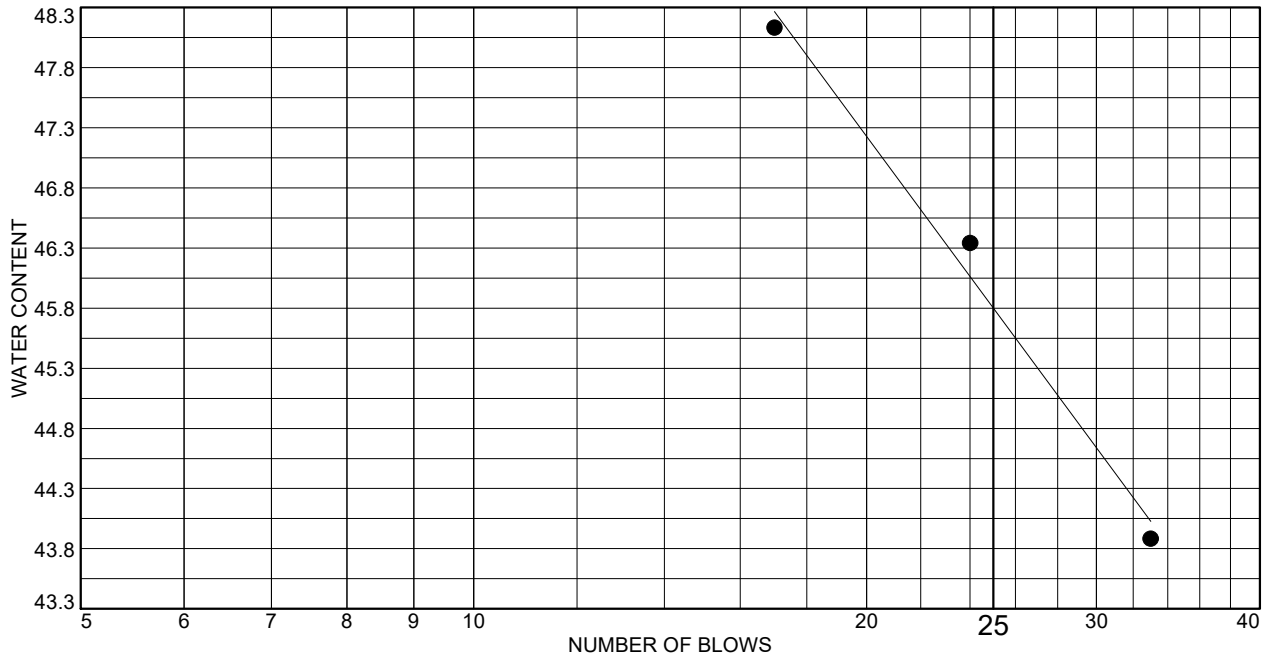
Client: University Property Group
Project: Elevate Development

Project No: JA20-4106-01 **Figure** #3A

Tested By: LB **Checked By:** IJ

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Reddish Brown, Sandy SILT	46	39	7	91.7	70.7	ML

Project No. JA20-4106-01 **Client:** University Property Group

Project: Elevate Development

Source of Sample: Onsite
Sample Number: 3

Kessel Engineering Group

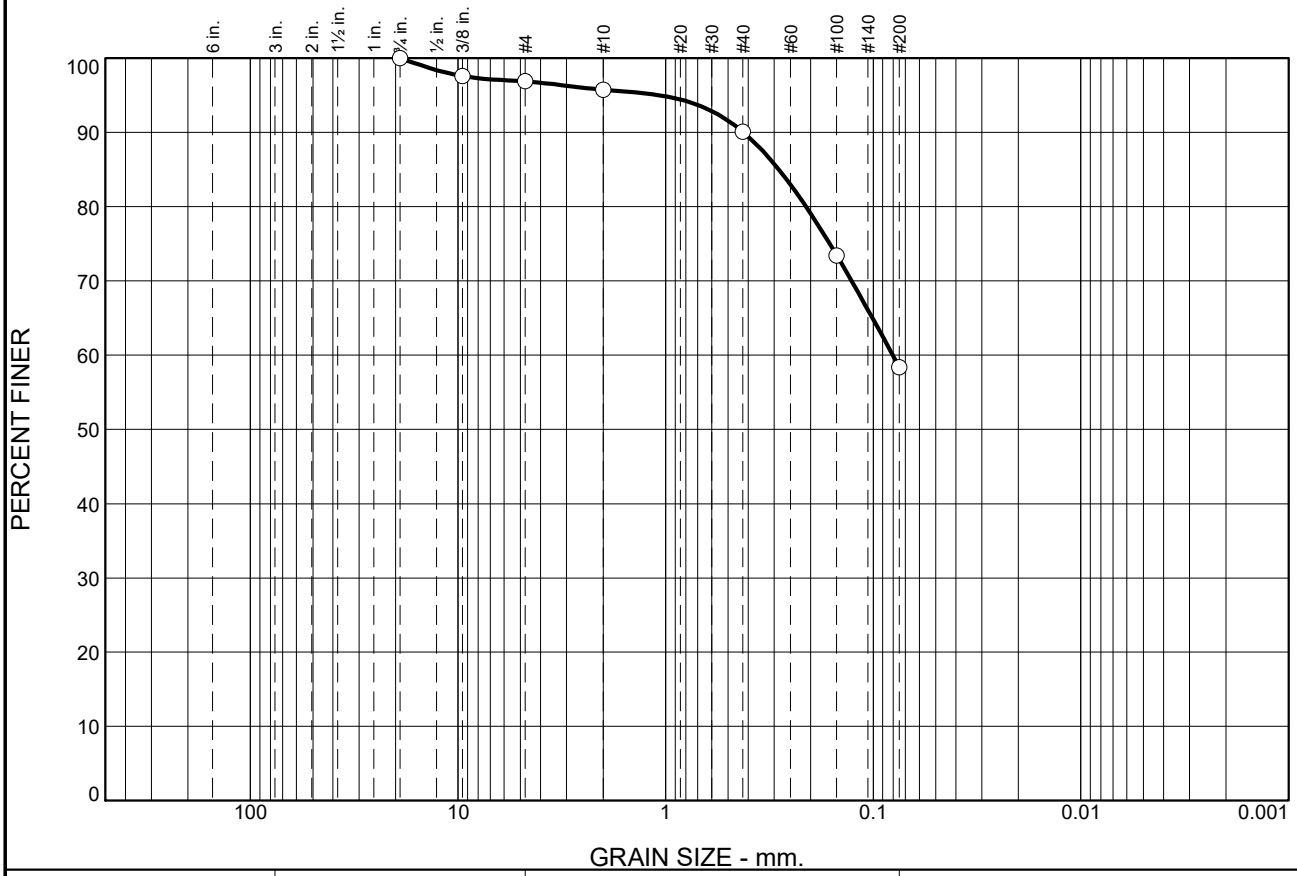
Asheville, NC

Remarks:
● TP-19 at -5 Feet

Figure #3B

Tested By: LB **Checked By:** IJ

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.1	1.2	5.6	31.7	58.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
3/8"	97.6		
#4	96.9		
#10	95.7		
#40	90.1		
#100	73.4		
#200	58.4		

* (no specification provided)

Material Description

Reddish Brown, Sandy SILT

Atterberg Limits

PL= 34 LL= 35 PI= 1

Coefficients

D_{90}= 0.4213 D_{85}= 0.2851 D_{60}= 0.0806
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

TP-20 at -5 Feet

Source of Sample: Onsite
Sample Number: 4

Date: 1/20/21

Kessel Engineering Group

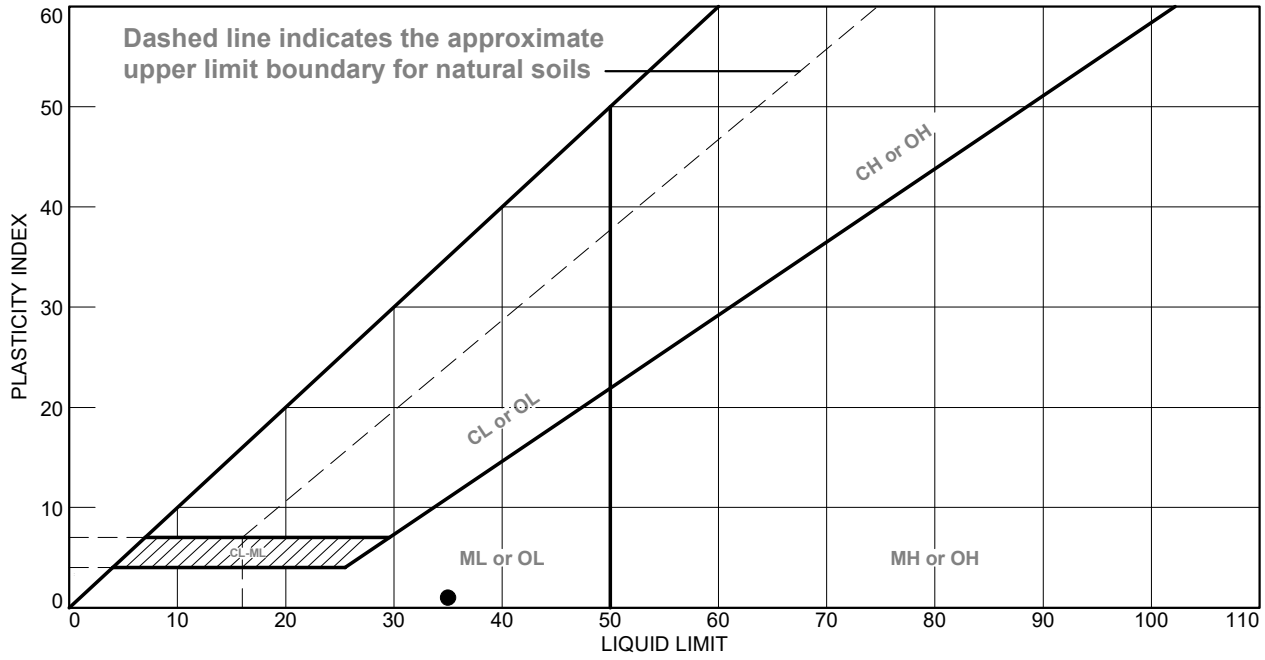
Asheville, NC

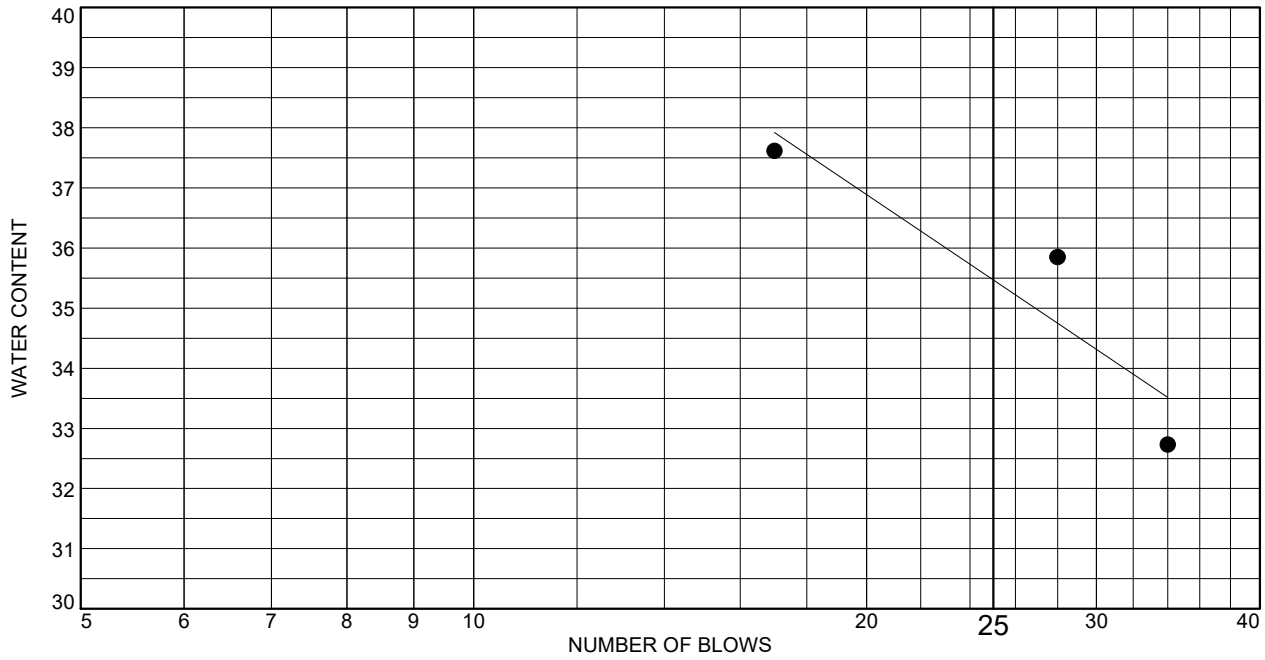
Client: University Property Group
Project: Elevate Development

Project No: JA20-4106-01 **Figure** #4A

Tested By: LB **Checked By:** IJ

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Reddish Brown, Sandy SILT	35	34	1	90.1	58.4	ML

Project No. JA20-4106-01 **Client:** University Property Group

Project: Elevate Development

Source of Sample: Onsite
Sample Number: 4

Kessel Engineering Group

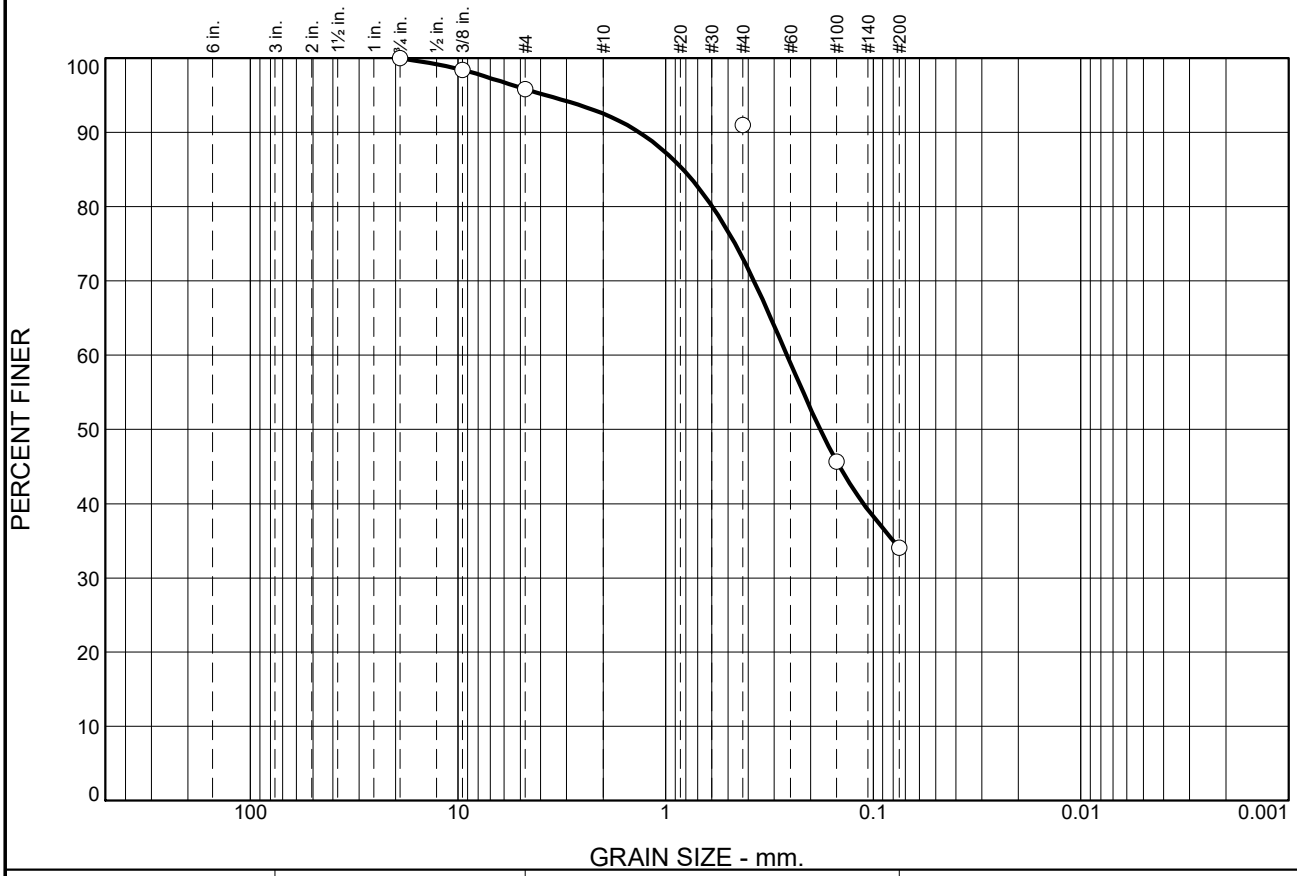
Asheville, NC

Remarks:
● TP-20 at -5 Feet

Figure #4B

Tested By: LB **Checked By:** IJ

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.2	3.3	19.5	38.9	34.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
3/8"	98.4		
#4	95.8		
#40	73.0		
#100	45.7		
#200	34.1		

* (no specification provided)

Material Description

Dark Gray, Slightly Micaceous, Silty, Fine to Medium SAND

Atterberg Limits

PL= 34 LL= 37 PI= 3

Coefficients

D_{90}= 1.3398 D_{85}= 0.8249 D_{60}= 0.2606
D_{50}= 0.1802 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

TP-21 at -3 Feet

Source of Sample: Onsite
Sample Number: 5

Date: 1/20/21

Kessel Engineering Group

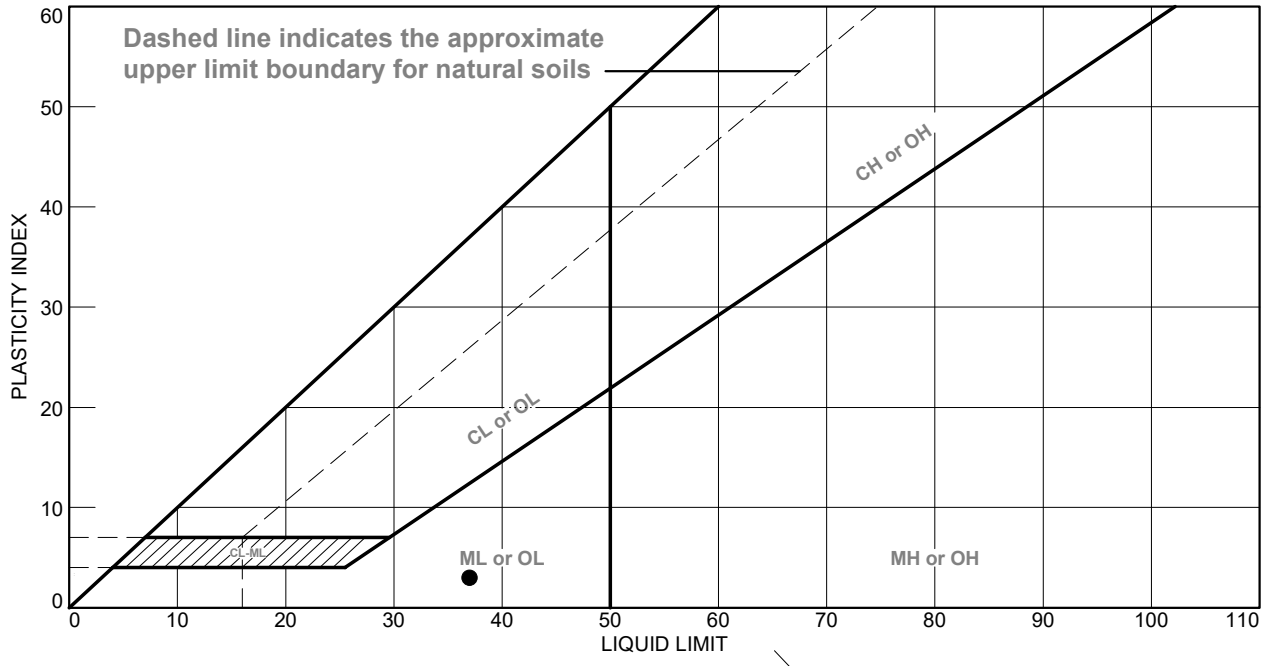
Asheville, NC

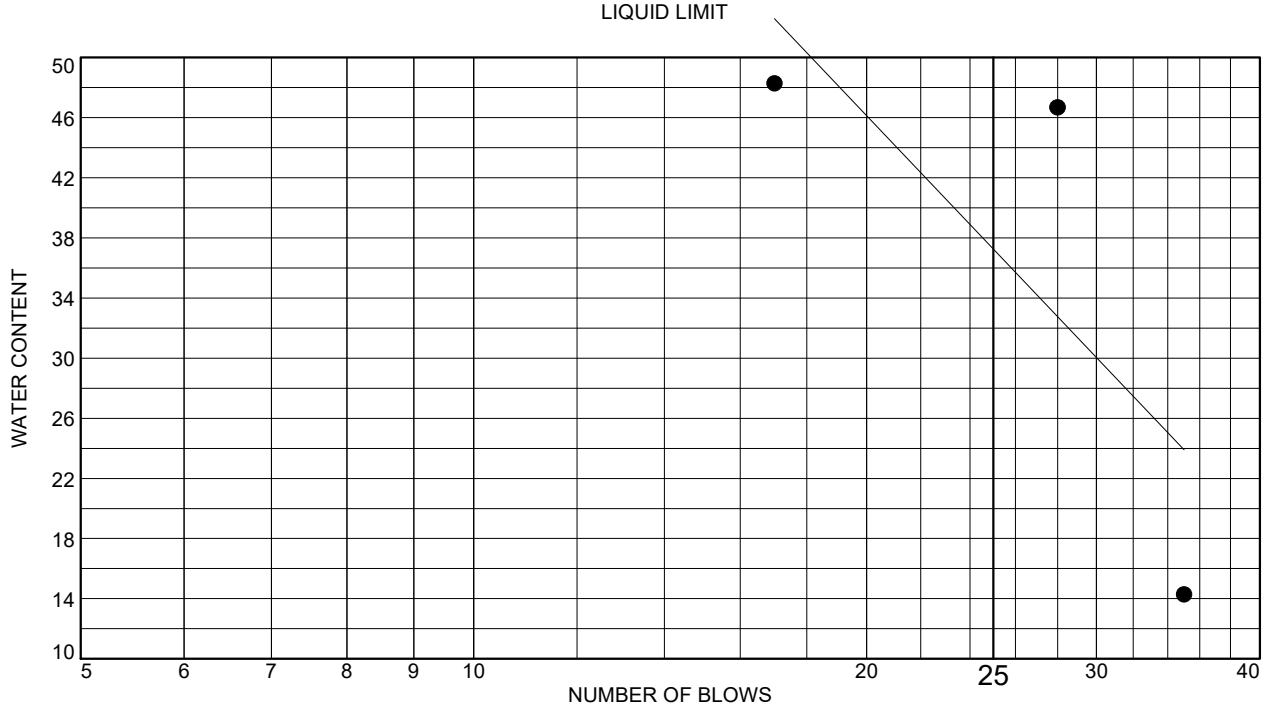
Client: University Property Group
Project: Elevate Development

Project No: JA20-4106-01 **Figure** #5A

Tested By: LB **Checked By:** IJ

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark Gray, Slightly Micaceous, Silty, Fine to Medium SAND	37	34	3	73.0	34.1	SM

Project No. JA20-4106-01 **Client:** University Property Group

Project: Elevate Development

Source of Sample: Onsite
Sample Number: 5

Kessel Engineering Group

Asheville, NC

Remarks:
● TP-21 at -3 Feet

Figure #5B

Tested By: LB **Checked By:** IJ

SECTION 02090
ROCK EXCAVATION & BLASTING

1.0 GENERAL

1.1 Description: The Contractor shall furnish all materials, labor, equipment, supplies and incidentals necessary to complete all rock excavation and blasting in a safe manner and as required for the successful completion of the project to the satisfaction of the engineer and as shown on the plans, and as specified herein and related sections of the specifications.

1.2 "Rock Excavation", in all situations including trenches, pits and open excavations, shall be defined as the excavation of any hard, naturally occurring, solid ledge rock (igneous, metamorphic and sedimentary) which requires the use of explosives and/or special impact tools such as jackhammers, sledge hammers, chisels, or similar devices specifically designed for use in cutting or breaking rock. Rock excavation shall be as further defined in paragraphs 1.2.1 and 1.2.2.

1.2.1 Rock excavation for trenches and pits shall be defined as the removal of a formation that cannot be excavated without systematic drilling and blasting that is performed only for the purposes of utility installation. In contrast, normal or earth excavation is a formation that when plowed or ripped, breaks down into small enough pieces to be easily moved, can be loaded in hauling units, and can be readily incorporated into an embankment or foundation in relatively thin layers. Boulders larger than 1 cubic yard shall be classified as rock. The Contractor, if requested, shall prove that material should be classified as trench rock excavation, by demonstration that the material cannot be removed with a backhoe equipped with a 36" bucket with rock teeth placed on a 345 hp 100,000 lb class excavator with a drawbar pull of 75,920 lb. The Contractor shall, if requested, provide equipment specification data verifying the above minimum-rated equipment will be used for demonstration purposes. Such equipment shall be in good repair and proper working condition.

1.2.2 Rock excavation in open excavations shall be defined as the removal of a formation that cannot be excavated without systematic drilling and blasting that is not for the purposes of utility installation. In contrast, normal or earth excavation is a formation that, when plowed and ripped, breaks down into small enough pieces to be easily moved, can be loaded in hauling units, and can be readily incorporated into an embankment or foundation in relatively thin layers. Boulders larger than 1 cubic yard shall be classified as rock. The Contractor, if requested shall prove that material should be classified as rock excavation, by providing a demonstration that the material cannot be ripped with a D-8 crawler tractor with 310 flywheel horsepower or equal, pulling a single-tooth ripper with ripping performed in a criss-cross pattern or against the natural bedding plane. The Contractor shall, if requested, provide equipment specification data verifying the above minimum-rated equipment will be used for demonstration purposes. Such equipment shall be in good repair and in proper working condition. This classification does not include materials such as loose rock, concrete or other materials that can be moved by means other than drilling and blasting or drilling and wedging, but which, for reasons of economy in excavating the Contractor prefers to remove by drilling and blasting.

Method of payment for rock excavation shall be at the quoted unit prices per cubic yard in the Bid Form. Final payment for rock excavation will be based on the actual cubic yards of rock excavation performed and will be paid for at the unit price quoted for "rock excavation" in the bid form. There will be no distinction made in payment for trench rock excavation or rock excavation in open areas.

1.3 Contractor shall exercise extreme care in all blasting related operations as required to prevent any damage to all public or private properties, structures, utilities, facilities and residences. No blasting shall occur outside the hours of 8:30 a.m. to 3:30 p.m., Monday through Saturday unless approved otherwise by the engineer and any other agencies having jurisdiction.

1.4 It is required that the contractor engage the services of an independent, qualified blasting consultant, experienced in controlled blasting techniques for similar civil and hydraulic works, to prepare blasting plans, to supervise the installation of instruments, monitor blasting operations and to supervise the interpretation of recorded results. The contractor's employment and use of an independent blasting consultant will be mandantory, including all blast monitoring and record keeping. Independent blasting consultants shall have a minimum five years documented experience in the handling and use of explosives, related testing, monitoring and seismic surveys. **If the contractor elects to excavate rock using non-explosive techniques, the requirement to engage the services of an independent, qualified blasting consultant, will be optional at the contractor's discretion.**

1.4.1 The blasting consultant shall develop project specific blasting plans for the contractor's use. The blasting plan shall, at a minimum, contain a schedule of neighborhood preblast advisories and notifications, preblast and postblast structural surveys, a tabulation of the nearest distances to structures within the specified blast generated seismic influence zone, detailed safety and security measures to be implemented, the types and use of blast monitoring equipment, blast hole diameters and depths, the types and amounts of explosive to be used, the length of the stemming columns and the types of stemming material, the type of initiation system to be used, the methods used to control fly rock and sufficient related information to safely and successfully execute blasing operations.

1.4.2 The blasting plan conditions or recommendations and any conditions shown on the plans or imposed herein shall not, in any way, relieve the contractor of his sole responsibility for safety, loss of life, property damage and obtaining adequate rock breakage and limiting rock breakage to within the final lines and grades necessary for the proper completion of the project.

1.5 The contractor shall use experienced, blasters, blast technicians, competent supervisors and skilled labor for all blasting operations. Such persons shall possess all required federal, state, and local licenses and/or permits.

1.5.1 Blasting, the use of explosives and blaster qualifications shall be in strict compliance with the North Carolina Occupational Safety and Health Standards for the Construction Industry, Subpart U – "Blasting and the Use of Explosives," Sections 1926.900 through 1926.914, latest edition.

1.5.2 The contractor shall obtain all the required permits, and pay all fees related thereto, from local, state and federal agencies for transportation, storage and use of explosives and notify the local fire marshall and the engineer prior to the commencing any blasting operations. The contractor is required to have insurance specifically covering all practices and obligations related to blasting and the use of explosives.

2.0 MATERIALS

2.1 The contractor shall furnish all materials, equipment, labor and incidentals required to successfully accomplish all work to the satisfaction of the engineer and owner.

2.2 Explosives shall be handled, transported, used, controlled, and monitored as prescribed by the most stringent of rules specified in OSHA Standards, NFPA – Code for Explosive Materials and local, state or federal codes and ordinances.

2.3 No overnight storage of explosives will be allowed on the project site. Only the amount of explosives to be used each day shall be on the jobsite. Unused explosives shall be removed from the project at the end of the working day. All loaded blast holes are to be shot the day they are loaded.

2.4 Blasting mats shall weigh at least 25 pounds per square foot or greater if necessary to prevent any degree of fly material as a result of blasting. Mats shall be a minimum of 6 feet by 10 feet and shall be equipped with suitable placement attachments.

2.5 The contractor shall institute a system of audible signals to warn of impending blasts and in accordance with all agencies having jurisdiction.

2.5.1 The contractor shall erect signboards of adequate size stating that blasting operations are taking place in the area. Such signs shall be clearly visible at all points of access to the area, shall clearly describe the audible signal system for warning of impending blasts and shall be in accordance with all agencies having jurisdiction.

2.5.2 The contractor shall mark all day storage places and explosives transport vehicles with signs stating clearly and boldly, DANGEROUS EXPLOSIVES and any other signing required by regulatory bodies.

2.6 The blasting consultant, engaged by the contractor, shall provide and operate properly calibrated blast monitoring seismographs and air blast overpressure/sound monitoring devices, at the nearest structures in the vicinity of blasting operations to accurately measure and record particle velocity and air overpressure.

2.7 All fill materials, borrow materials, select fill, bedding materials, stone and any other materials that are, in the engineer's opinion, necessary due to rock excavation will be provided by the contractor at the contractor's sole expense. All types, grades and quality of materials used for

fill, backfill, bedding or other uses associated with rock excavation shall be in accordance with other related sections of these specifications.

3.0 EXECUTION

3.1 The primary objective for blasting rock is to construct excavations where the rock outside of the excavation will be undisturbed and the shape of the excavation will conform to the lines and grades indicated on the plans or specified herein. It is the responsibility of the contractor to conduct their operations in such a manner that this objective is safely achieved.

3.1.1 Unless shown otherwise on the plans, rock shall be excavated and paid for to the following limits. Additional rock excavation beyond the limits indicated on the plans or specified herein, or associated waste material disposal, borrow material or incidentals will not be paid for and will be performed at the contractor's sole expense.

Trenches		
	Sidewalls:	Pipe outside diameter plus 8 inches each side calculated with trench sidewalls assumed to be vertical
	Floor:	Pipe outside diameter plus 6 inches below the pipe to the lines, grades or depth indicated on the plans
Structures		
	Foundation:	12 inches outside and below the bearing depth of the foundation unless shown otherwise on the plans or allowed by the engineer or architect
	Walls:	24 inches beyond the outermost vertical structure wall or foundation limits other than footings
	Slabs:	6 inches below the concrete slab bearing elevation
Roadways		
	Subgrade:	Stone base course bearing elevation plus 12 inches additional depth or a minimum of 2 feet below the finished road surface elevation whichever is greater
	Ditches:	Only depth as necessary to provide ditch profile specified

3.2 The contractor shall notify the engineer a minimum of 48 hours in advance of loading explosives or commencing any other blasting related operations.

3.3 Unless approved otherwise by the engineer, all blasting shall occur when a representative of the engineer and owner is present to witness each blast.

3.4 Explosives shall not be used as a means of transporting materials outside the excavation prism.

3.4.1 Inadequately confined or unconfined surface charges are prohibited.

3.4.2 Except for presplitting as specified below, rock cuts requiring systematic drilling and blasting shall have the excavated material removed in lifts with a maximum lift height of 25 feet.

3.4.3 Unless controlled by other requirements in these specifications, sub-drilling for final lines and grades shall not be greater than 3 feet below excavation grade.

3.4.4 Shots shall be designed so that where possible, the explosive energy is directed toward the developed free face.

3.4.5 Explosives shall be of such quantity and quality, and shall be used in such a manner as to minimally open seams or otherwise damage rock outside the prescribed limits of excavation. The firing systems of general blast holes shall be controlled by the use of delay detonators, and explosives used for any single period of delay, shall be the minimum required.

3.4.6 Blasting within 300 feet of any concrete which has been in placed less than 28 days will not be allowed.

3.5 Particle velocity shall not exceed 0.5 inches per second and air overpressure (blast) shall not exceed 0.029 psi (140 dBL) as measured by the blasting consultant engaged by the contractor. Where local conditions dictate or recommended by the blasting consultant for site specific conditions, particle velocity and air overpressure levels shall be reduced below these levels.

3.5.1 The blasting consultant shall prepare a report for each blasting operation or shot performed. The contractor shall provide the engineer with copies of all blast reports prepared by the blast consultant. In reporting a shot, the distance from the shot to each recorder, amount of explosives used in each delay, the total amount of explosives used and the time shall be noted. Blast reports shall be submitted to the engineer within 24 hours following each shot or blasting operation performed. No separate or direct payment will be made to the contractor for the use of blasting consultants, monitoring equipment, monitoring of blasts, record keeping and reports and any other incidental costs.

3.6 Cover the area to be shot with blasting mats or other approved type of protective material that will prevent the scattering of rock, fragments or any other fly material. Give ample warning to all persons within the vicinity prior to blasting and provide signals warning of danger in suitable places to alert people in vehicles before firing any blast.

3.7 After a blast has been fired, the blaster shall make a careful inspection to determine that all charges have exploded before employees are allowed to return to the operation. Misfires shall be corrected in accordance with the requirements of the applicable portions of Federal, State, and/or local safety codes for blasting. The contractor shall be responsible for any and all damages to property or injury to persons resulting from blasting, or accidental or premature explosions that may occur in connection with the use of explosives.

3.8 All loose and shattered rock or other loose material, which may endanger any structure or the workers, shall be removed and the excavation site made safe before proceeding with the work. After muck removal and before drilling of blast holes for a new round, the face shall be cleaned and thoroughly examined for missed holes and unexploded powder. Blasting techniques shall be developed prior to blasting and improved as work progresses. The fact that the removal of loose or shattered rock or other loose material may enlarge the excavation beyond the required limits shall not relieve the contractor of the responsibility for removal of such material and replacement of suitable materials at his sole expense.

3.9 All rock excavation with design slopes of 1 horizontal to 1 vertical, or steeper, shall be excavated by using controlled blasting techniques. All line holes for controlled blasting shall be 2 to 3 inches in diameter. The contractor shall test the selected methods by making test shots within the interior of the excavation as needed to confirm the suitability of selected methods. The test shots shall be so placed that they will pose no threat to the final rock face. If the test results are unacceptable, the contractor shall modify his proposed blasting method and perform other tests until the method produces acceptable results. Unless the proposed method provides acceptable results as judged by the engineer, the contractor shall not use the proposed method of controlled blasting against any final rock faces or in any place where the final face will be damaged by the test blast or blasts.

3.9.1 Spacing for presplit line holes shall be 2 feet on centers. Maximum depth of vertical presplit holes for a single drilling setup shall not be greater than 25 linear feet. Successive sets of presplit holes may have their collars slightly offset from the design slopes, but shall be so inclined that all sets closely approximate the design slopes.

3.10 In case damage from blasting occurs to existing structures, public or private properties, to any portion of the work, or to any material surrounding the project, the contractor shall remove such damaged work, repair the work, and replace the material and otherwise perform such work for repair or replacement to the satisfaction of the engineer and owner at the constractor's sole expense.

3.11 All excavated rock material and any other waste materials related to or generated by rock excavation, unless specifically stipulated on the plans to be incorporated into the project, shall be removed from the project site and disposed of offsite by the contractor at a disposal site secured and properly permitted by the contractor. All costs associated with the disposal of rock and other waste materials shall be at the contractor's sole expense with no additional cost to the owner.

3.12 The contractor shall be responsible for providing all borrow material, select fill materials, stone bedding material and any other materials needed for the proper completion of the work, to the satisfaction of the engineer, as a result of rock excavation. All costs associated with the provision of these materials, including but not limited to, the securing of suitable borrow source(s), all testing of borrow materials for suitability, all loading, hauling, unloading, placing, compacting and incidental costs and work shall be at the sole expense of the contractor. Borrow

materials, stone, bedding materials and other materials needed due to or related to rock excavation shall meet the approval of the engineer and shall be in accordance with other applicable sections of these specifications.

4.0 METHOD OF MEASUREMENT & BASIS OF PAYMENT

4.1 When rock is encountered during excavation or construction, the contractor is responsible for exposing the surface of the rock and allowing the engineer adequate time to profile the surface of the rock for use in estimating the volume removed for payment purposes. The contractor shall assist and allow the engineer adequate time to profile the rock surface prior to and following the completion of a given section or area of rock excavation. The contractor shall be responsible for implementing all necessary safety and security measures as needed to allow rock surfaces to remain exposed for measurement by the engineer. Payment for rock excavation will be made on the basis of the engineer's field calculated volumes based on the actual rock quantity.

4.2 Payment for rock excavation will be made to lines, grades and limits shown on the plans and specified herein. The excavation of rock beyond the specified limits, including all associated work, materials, labor and incidentals, will not be paid for and shall be corrected to the engineer's satisfaction at the contractor's expense.

4.3 The contractor shall be paid for the actual amount of rock excavation, based on the engineer's quantity measured and estimated during construction, at the price per cubic yard stipulated in the bid form. Payment for rock excavation shall include all labor, materials, equipment, supplies, drilling, overburden and mattings, explosives, safety equipment and provisions, signing, permits, fees, blasting consultants, monitoring equipment, specialists, excavation, loading, unloading, testing of borrow sources, obtainment of borrow sources, borrow materials and placement, disposal of waste materials offsite, bedding and fill materials, stone, compaction, construction delays, damage repair and any other incidentals necessary to properly complete all rock excavation to the satisfaction of the engineer and owner.

END OF SECTION

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SECTION 02110
CLEARING, GRUBBING AND DEMOLITION

1.0 GENERAL

1.1 Description: The Contractor shall furnish all materials, labor, equipment, supplies, maintenance and incidentals necessary to perform all clearing, grubbing and demolition operations as necessary to properly complete the project to the satisfaction of the engineer and owner. All clearing, grubbing and demolition shall be performed in accordance with all local, state and national codes, standards and regulations at the contractor's expense. The work of clearing, demolition and grubbing shall be performed within the project limits as indicated by the plans and as necessary for the successful completion of the project. The contractor will be solely responsible for making investigations and determining the extent of clearing, grubbing and demolition operations required prior to submitting a bid including all clearing, grubbing and demolition necessary for the proper completion of all work to the satisfaction of the engineer.

1.2 The contractor shall install all erosion control measures shown on the plans and as specified in other sections prior to commencing clearing, grubbing and demolition operations. Where necessary due to conflicts, erosion control measures shall be installed immediately following clearing and grubbing operations for a particular area of construction.

1.3 The contractor shall take all the necessary measures to prevent any damage to any public or private properties, structures, utilities, facilities, etc. Should any damage occur, the contractor shall be fully responsible for making the necessary repairs or replacements, at the contractor's expense, to the satisfaction of the engineer and owner.

1.4 The contractor will be solely responsible for making investigations and determining the existence, exact locations, sizes, depths, extent and material types of all existing utilities that may be affected by project activities prior to commencing construction. All existing utilities and related facilities are not shown on the plans and the locations shown on the plans may have been approximated. Any damage incurred to existing utilities, whether shown on the plans, not shown on the plans or incorrectly shown on the plans are the responsibility of the contractor and shall be repaired to the original or better condition, to the satisfaction of the utility owner and engineer, at the sole expense of the contractor.

1.4.1 The contractor shall be responsible for coordinating all construction with all utility companies affected by the project. Except in an emergency, the contractor shall not operate any controls on any existing utility system or otherwise change or affect the operation of the utility without prior approval of the utility owner.

1.5 The contractor shall be responsible for all job site safety and security including, but not limited to, work zone traffic control and signing. The contractor shall provide and maintain adequate work zone traffic control in accordance the latest editions of the NCDOT "Standard Specifications for Roads and Structures," the NCDOT "Roadway Standard Drawings" the

"Manual of Uniform Traffic Control Devices" and all site specific conditions imposed by the NCDOT local Division Office.

1.6 There shall be no burning allowed of any materials associated with the project either within the project area or at any remote location. All waste materials, that will not be incorporated into the work, resulting from clearing, grubbing, and demolition operations, whether natural or manmade materials, shall be disposed of, at the contractor's expense, off the owner's property in accordance with applicable regulations.

2.0 MATERIALS

2.1 The contractor shall furnish all materials, equipment, labor and incidentals required to successfully accomplish all clearing, demolition and grubbing to the satisfaction of the engineer and owner.

3.0 EXECUTION

3.1 The contractor shall perform all clearing of the project area and related areas, approved by the owner and engineer, as needed to facilitate successful construction consisting of the cutting, removal, and satisfactory disposal of all trees, vegetation, structures and foundations to be demolished, pavements and bases to be removed, utilities to be removed or abandoned and debris at the contractor's expense. The contractor shall perform all grubbing consisting of the loading, removing, hauling and properly permitted disposal of all cuttings, stumps, vegetation, organic matter, structures to be demolished and other natural or manmade debris at a location off the owner's property at the contractor's expense. All applicable permits and offsite disposal locations shall be obtained by the contractor at the contractor's expense. No additional payment will be made for clearing and grubbing work at offsite locations related to construction such as borrow sites.

3.1.1 The work of clearing, grubbing and demolition shall include, at the contractor's expense, the complete removal and offsite disposal of all below ground foundations, footings, utilities, vaults, tanks and other manmade improvements, whether abandoned or identified to be abandoned, unless specifically approved otherwise by the engineer.

3.1.2 The work of clearing, grubbing and demolition shall also include the formal abandonment of any wells identified on the plans to be abandoned that are no longer in use. The wells shall be abandoned, at the contractor's expense, in accordance with NC regulations by a certified well driller. The abandonment procedure shall include completely filling the entire well depth with 3,000 psi cement grout and completely removing the casing to a depth of 10 feet below grade. The contractor shall submit copies of the well abandonment record to the NC Division of Environmental Management and the engineer.

3.2 All material containing organic matter, such as root mat and other vegetative matter, shall be considered vegetation and removed as part of the work of grubbing. Earth or soil, which in the opinion of the engineer is clean, will not be considered as clearing debris. Topsoil will be treated as clearing debris. However, if allowed by other sections of these specifications, clean topsoil may be used as a final cover on areas to be grassed. Topsoil is defined as friable clay loam surface soil. Satisfactory topsoil is shall be, in the opinion of the engineer, reasonably free of subsoil, clay lumps, stones, and other objects over 2 inches in diameter, and without weeds, roots, heavy organic matter, debris and other objectionable material.

3.3 The contractor shall take the necessary measures and precautions to protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within the drip line. The contractor shall provide all temporary guards and measures necessary to protect trees and vegetation to be left standing at the contractor's expense. The contractor shall water trees and shrubs to be perserved within the project limits on an as needed basis. The contractor shall conduct his operations in a manner to prevent limb, bark, or root injuries to trees, shrubs, or other types of vegetation that are to remain growing and also to prevent damage to adjacent property. Should such injuries occur, all rough edges of scarred areas shall be made reasonably smooth in accordance with generally accepted horticultural practice. Any such plants that are damaged by any construction operations to such an extent as to destroy their value, shall be cut and disposed of by the contractor, when so directed by the engineer.

3.4 The work of clearing, demolition and grubbing shall also include the removal and satisfactory disposal of crops, weeds, and other annual growth; the removal and satisfactory disposal of fences, steps, walls, chimneys, column footings, other footings, structures, buildings, foundation slabs, basements, other foundation components, pavements and base materials, signs, junked vehicles, and other rubble and debris if identified to be demolished or removed; and the filling of holes and depressions all at the contractor's expense. Any items which the wishes to retain ownership of shall be salvaged by the contractor, free of damage, and stored on the project site at a location(s) to be designated by the owner.

3.5 As part of clearing and grubbing operations, the contractor will be required to cut off and plug, as directed by the engineer, any storm sewer, water line, sewer line or other utility to be abandoned or intercepted during the construction of the project and remove any septic tank or portion thereof to be abandoned or intercepted during the construction of the project at the contractor's expense.

3.6 Clearing, demolition & grubbing operations shall be completed sufficiently in advance of grading operations as may be necessary to prevent any of the debris from the clearing and grubbing operations from interfering with earthwork or other construction operations.

3.7 All work under this section shall be performed in a manner which will prevent and soil erosion and loss of sedimentation. The contractor shall provide all erosion control work,

temporary or permanent, as may be necessary to prevent erosion resulting from clearing and grubbing operations. At all locations possible, the installation of temporary or permanent erosion control measures shall be performed prior to commencing clearing, grubbing or demolitions activities.

3.7 The contractor is required to completely remove all demolition, clearing and grubbing materials including, but not limited to, all stumps and other vegetative matter and dispose of all waste generated off the owner's property at an approved site at the contractor's sole expense. The contractor shall be responsible for paying all landfill related fees and acquiring any additional permits, at the contractor's expense, that may be necessary for the successful completion of the project to the satisfaction of the engineer. The contractor is responsible for locating properly permitted landfills or disposal facilities that will except the particular types of wastes generated by the project and transporting all waste materials to the appropriate locations.

3.8 All holes and other depressions shall be filled, and the area brought to sufficiently uniform contour to the satisfaction of the engineer. This work shall be done regardless of whether the irregularities were the result of the contractor's operations or were originally existing.

4.0 METHOD OF MEASUREMENT & BASIS OF PAYMENT

4.1 There will be no direct payment for any work covered under this specification section. All work, materials, equipment, labor, testing, incidentals and appurtenances described in this section shall not be measured and paid for as such but shall all be treated as incidental work. The contractor is responsible for including the price of all work covered herein in the prices stipulated for related work in the bid form.

END OF SECTION

SECTION 02200
EARTHWORK

1.0 GENERAL

1.1 Description: The Contractor shall furnish all materials, labor, equipment, supplies and incidentals necessary to complete all proposed earthwork, including but not limited to, excavation, backfill, undercut excavation, fill, backfill, compaction, provision and installation of borrow materials, embankment formation, subgrade preparation, removal and offsite disposal of all waste, demolished or excess materials, grading and land contouring to the satisfaction of the engineer, and as shown on the plans, specified herein and as specified in related sections.

1.2 The owner may, at their discretion, obtain the services of a licensed geotechnical consultant, at the owner's expense, to sample and test soil parameters to verify that soils meet project requirements and perform compaction density testing of soils, fill, backfill, subgrade and base materials. A licensed geotechnical engineer shall be any qualified agency having a NC professional soils engineer on staff, experienced in soil mechanics, testing and soils science and having the necessary staff and properly calibrated equipment to accurately test soil compaction density and the necessary related parameters. The owner may, at their discretion, select not to have or to have a representative of the geotechnical consultant on the project site periodically or full time, depending upon job conditions and progress. The owner's geotechnical consultant shall have the authority to approve or disapprove earthwork on the basis of compliance with project specific requirements and parameters. Any work that does not comply with project requirements, shall be repaired, replaced or otherwise corrected by the contractor at the contractor's expense, to the satisfaction of the engineer and owner's geotechnical engineer. All costs associated with retesting due to non-compliant work shall be paid for by the contractor until such time the geotechnical consultant is satisfied that the work has been corrected. The contractor is responsible, at their expense, for engaging the services of qualified professional geotechnical consultant(s) as necessary to monitor earthwork operations and provide quality control of operations to insure that construction is completed in accordance with the contract documents.

1.3 Classified Excavation: All excavation, with the exception of Rock Excavation and Undercut Excavation as defined herein, shall be "unclassified" or defined as Earth Excavation regardless of materials, obstructions, positions or conditions encountered whether naturally occurring or manmade. Earth excavation shall include the removal of and offsite disposal of rock excavation, structures, pavements and other obstructions, utilities, underground structures, together with any other type of earth and manmade material encountered necessary to complete all work. No additional or separate payment shall be made for earth excavation including any incidentals, related fees or any other costs or losses incurred by the contractor. All excavation that is not classified rock excavation or undercut excavation will be classified as earth excavation regardless of conditions, situations or materials encountered. All payment for

earth excavation shall not be measured but shall be included in the lump sum bid for completing all work.

1.3.1 Rock Excavation: shall be defined, performed and measured in accordance with *Section 02090, Rock Excavation.* The contractor shall include all costs associated with rock excavation in their bid price for all work as necessary to complete the entire project.

1.3.2 Undercut Excavation with Stone Backfill: shall include removing unsuitable existing materials beyond the required limits of subgrade elevations. When excavation has reached the required subgrade elevations, the contractor shall contact the engineer, and the owner's geotechnical engineer to conduct a site visit. If the engineer, based on advice from the owner's geotechnical engineer, determines that the bearing materials at the required subgrade elevations are unsuitable, the contractor shall continue the excavation to a depth approved by the engineer, remove unsuitable material from the project site, and replace excavated material with select stone or aggregate borrow materials. The select stone borrow material for replacing the excavated undercut material shall be an approved aggregate replacement material. Approved aggregate replacement materials for "Undercut Excavation with Stone Backfill" shall include NCDOT #57 washed stone, NCDOT ABC stone, NCDOT Class A, B, 1 or 2 Rip Raps or a combination of these materials depending upon the site specific recommendations of the owner's geotechnical engineer. All approved aggregate replacement materials shall be well consolidated with suitable vibratory compaction equipment and compacted to a minimum of 100 percent density per AASHTO T 180. Undercut excavation with stone backfill shall also include the complete encapsulation of aggregate replacement materials with a heavy duty, non-woven engineering fabric such as Mirafi 140N or an approved equal. All engineering fabric seams shall be overlapped by a minimum of 2 feet. Undercut excavation shall not include excavation, disposal and replacement of materials necessary to reach the standard subgrade elevations indicated on the plans. Undercut excavation with stone backfill shall only include additional excavation beyond subgrade limits which has been approved by the engineer. Undercut excavation extending beyond the limits specified by the engineer shall not be paid for but shall be properly repaired at the contractor's expense. Undercut excavation with stone backfill shall include the removal and disposal of unsuitable materials off the owner's property, the provision, placement and compaction of approved aggregate replacement materials to replace the volume of removed materials, the provision and installation of engineering fabric to completely encapsulate the aggregate replacement materials and all other related work and incidentals to the satisfaction of the owner's geotechnical engineer and the engineer. Topsoil removal shall not be paid for regardless of locations or depths encountered. Materials that are damaged in part due to construction activities, practices or schedules, such as foundation excavations subjected to rain or water intrusion, freezing and subsequently must be removed, shall not be considered undercut excavation and shall be repaired or corrected by the contractor at the

contractor's expense. The contractor shall be paid for approved undercut excavation with stone backfill at the unit price stipulated in the contract. Final payment for undercut excavation with stone backfill will be adjusted to the actual cubic yards of undercut excavation performed and will be paid for at the unit price quoted for "undercut excavation with stone backfill".

1.3.3 Undercut Excavation with Soil Backfill: shall include removing unsuitable existing materials beyond the required limits of subgrade elevations. When excavation has reached the required subgrade elevations, the contractor shall contact the engineer, and the owner's geotechnical engineer to conduct a site visit. If the engineer, based on advice from the owner's geotechnical engineer, determines that the bearing materials at the required subgrade elevations are unsuitable, the contractor shall continue the excavation to a depth approved by the engineer, remove unsuitable material for the project site, and replace excavated material with select borrow soil material. The select borrow soil material for replacing the excavated undercut material shall be provided by the contractor from an approved off-site source and shall be in accordance with paragraphs 2.2, 2.2.1, 2.2.2 and 3.13 of this specification section and acceptable to the owner's geotechnical engineer. All approved soil replacement materials shall be well compacted with suitable vibratory compaction equipment to a minimum of 98 percent standard Proctor maximum dry density as determined by ASTM D698. Undercut excavation with soil backfill may be placed on top of undercut excavation with stone backfill at the discretion of the Owner's geotechnical engineer. Undercut excavation shall not include excavation, disposal and replacement of materials necessary to reach the standard subgrade elevations indicated on the plans. Undercut excavation with soil backfill shall only include additional excavation beyond subgrade limits which has been approved by the engineer. Undercut excavation extending beyond the limits specified by the engineer shall not be paid for but shall be properly repaired at the contractor's expense. Undercut excavation with soil backfill shall include the removal and disposal of unsuitable materials off the owner's property, the provision, placement and compaction of approved borrow soil materials to replace the volume of removed materials and all other related work and incidentals to the satisfaction of the owner's geotechnical engineer and the engineer. Topsoil removal shall not be paid for regardless of locations or depths encountered. Materials that are damaged in part due to construction activities, practices or schedules, such as foundation excavations subjected to rain or water intrusion, freezing and subsequently must be removed, shall not be considered undercut excavation and shall be repaired or corrected by the contractor at the contractor's expense. The contractor shall be paid for approved undercut excavation with soil backfill at the unit price stipulated in the contract. Final payment for undercut excavation with soil backfill will be adjusted to the actual cubic yards of undercut excavation performed and will be paid for at the unit price quoted for "undercut excavation with soil backfill".

1.3.4 Unauthorized excavation consists of removing materials beyond the indicated or specified limits, subgrade elevations or the dimensions required to complete the work.

Unauthorized excavation, as well as remedial work directed by the owner's geotechnical engineer, shall be performed to the satisfaction of the engineer at the contractor's expense.

1.3.5 Earthwork is not "balanced." It is the bidder's responsibility to determine the actual quantities required to successfully complete the project and include all required earth excavation and all work in the base bid amount. The owner's geotechnical engineer will be responsible for determining the suitability or unsuitability of earthwork and related materials.

1.4 All work shall be in accordance with the provisions, rules and regulations of the North Carolina Department of Environment and Natural Resources and all other local, state and national agencies having jurisdiction.

1.5 The contractor shall be solely responsible for all job site safety and security.

1.5.1 The contractor shall be solely responsible for complying with all local, state and national codes, standards, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations and otherwise maintain safe jobsite conditions.

1.5.2 The contractor shall be solely responsible for work zone traffic control and signing. The contractor shall provide and maintain adequate work zone traffic control in accordance with the latest editions of the NCDOT "Standard Specifications for Roads and Structures," the NCDOT "Roadway Standard Drawings" the AASHTO "Manual of Uniform Traffic Control Devices" and all site specific conditions imposed by the NCDOT local Division Office.

1.6 The contractor shall be the party responsible for coordinating all construction with the owner, engineer, owner's geotechnical engineer, other contractors, subcontractors, utility companies and any other parties affected by the project. Except in an emergency, the contractor shall not operate any controls on any existing utility system without prior approval of the utility owner.

1.7 The contractor will be solely responsible for making investigations and determining the existence, exact locations, sizes, and material types of all existing utilities that may be affected by project activities prior to commencing construction. All existing utilities and related facilities are not shown on the plans and the locations shown on the plans may have been estimated based on available information. Any damage incurred to existing utilities, whether shown on the plans, not shown on the plans or incorrectly shown on the plans is the responsibility of the contractor and shall be repaired to the original or better condition, to the satisfaction of the utility owner and engineer, at the sole expense of the contractor. Should the position of any pole, guy wire, pipe, conduit, conductor or other utility or structure be such that its removal and/or adjustment is necessary to complete construction, such change will be done by the owner of the obstructions at the contractor's expense.

1.8 During the progress of the work, sidewalks and crossings shall be kept open for the passage of pedestrians. Unless otherwise authorized, drives, roads and streets shall not be obstructed; and unless the engineer authorizes the complete closing of a drive, road or street, the contractor shall take such measures as may be necessary to keep it open for traffic.

1.8.1 The contractor shall construct and maintain adequate and approved temporary walkways, roads and bridges over excavations and disturbed areas as may be necessary for the purpose of accommodating pedestrians to the satisfaction of the engineer. This shall include the contractor providing, installing and maintaining temporary pavements or gravel surfaces at his expense in a condition acceptable to the engineer. When no longer needed, temporary measures shall be removed, disposed of off the owner's property and the area restored to a condition acceptable to the engineer at the contractor's expense.

1.8.2 When earthwork or excavation impacts a drive, road, street or other vehicle route, the contractor shall perform construction in a manner that maintains the passage of vehicle traffic in a manner acceptable to the engineer and owner. This includes the provision, placement and periodic grading of temporary gravel surfaces and/or pavements at the contractor's expense. The contractor shall provide all periodic maintenance stone needed and associated grading and later removal and offsite disposal of all temporary measures at the contractor's expense. The contractor shall provide all traffic control measures necessary to provide for safe traffic passage at all times.

2.0 MATERIALS

2.1 The contractor shall be responsible for insuring that all construction materials are loaded, unloaded, stockpiled, hauled, distributed, covered, protected, installed and otherwise handled in a manner that will prevent weather damage or other damage thereto their quality or usefulness and which will insure delivery and installation in a sound and acceptable condition.

2.2 Backfill, Fill and Borrow Materials: shall be excavated, loaded, hauled, unloaded, placed and compacted by the contractor as necessary for the proper completion of the project. All material shall be clean material, free of vegetation, organic matter, rocks larger than 2 inches in any dimension or other deleterious materials. The contractor shall be responsible for drying and/or wetting fill, borrow, or backfill materials if necessary to achieve proper moisture content and the specified compaction criteria. If available and suitable, materials may be used from onsite excavation or shall be imported borrow material if not available onsite. Imported borrow material shall be provided as needed by the contractor, at their sole expense, as necessary for the proper completion of the project to the satisfaction of the engineer and owner.

2.2.1 When offsite borrow material is needed, the contractor shall be responsible for obtaining a suitable borrow source and having all borrow sources being considered tested for suitability by a qualified NC professional geotechnical engineer at the contractor's expense. If

the borrow material is found to be acceptable, and is acceptable to the engineer, the contractor shall be responsible for all permitting, excavating, hauling, placing and compacting the material all at the contractor's sole expense and as approved by the engineer. Borrow material, fill and backfill materials shall be in accordance with the following:

2.2.2 Suitable Soil Materials for fill, backfill and borrow shall be in accordance with ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, organic matter and other deleterious matter. Suitable soils shall have a Plasticity Index (PI) of less than 15 and a minimum density of 95 pounds per cubic foot at the specified degree of compaction.

2.2.3 Unsuitable Materials which shall not be allowed for use as borrow, fill or backfill material shall be any material classified by ASTM D 2487 as soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, PT or any soils containing organic material greater than 2% by weight, or any soils containing rocks or stones larger than 2 inches in any dimension, or any soils containing other materials objectionable to the engineer or any soils which cannot be compacted to specified percentage of maximum density given site specific moisture conditions.

2.3 Topsoil, unsuitable materials or any material containing organic or other objectionable materials shall not be incorporated into fill or backfill. Clean topsoil, free of roots, rocks, stones and debris, may be stockpiled at approved locations and used as a 4" topdressing on areas having slopes of 25% and less to the finished grades specified in all areas to be grassed. Where insufficient topsoil is available on the project site, the contractor shall provide from an acceptable source and place topsoil to a minimum depth of 4" for all areas to be grassed and having a finished slope of 25% and less. Any topsoil, unsuitable material or excess material which is not incorporated into the work shall be considered waste material and shall be removed and properly disposed of off the owner's property by the contractor at the contractor's expense. Any borrow, fill or other material necessary as a result of topsoil or other material removal from the project site shall be obtained, permitted, hauled, placed, compacted, graded and otherwise completed to the engineer's satisfaction by the contractor at the contractor's expense. No additional payment or compensation will be made to the contractor as a result of, or related to topsoil or other unsuitable materials regardless of site conditions or depths and limits encountered.

2.4 Any and all excess, waste or unsuitable materials shall be removed, hauled and disposed of off the project site, in accordance with applicable regulations, all at the contractor's sole expense unless the owner selects to retain ownership of any excess or removed materials from the site .

2.5 Crusher Screenings: where specified as a select material shall be a fine aggregate material consisting of crushed stone screenings (washed or unwashed) meeting the following gradations:

Sieve	% Passing
3/8 in.	100
#4	80 - 100
#10	65 - 95
#40	25 - 55
#200	0 - 20

2.6 Washed Stone: Unless specified otherwise, washed stone shall be a coarse aggregate material meeting the gradation requirements of NCDOT standard size No. 57 as specified in Section 1005 of the NCDOT "Standard Specifications for Roads and Structures."

2.7 Concrete: Unless specified otherwise on the plans or other sections of these specifications, all concrete and grouts shall be Portland cement concrete having a minimum compressive strength of 4,000 psi at 28 days. All concrete exposed to weather shall be air entrained. Concrete shall be NCDOT Class A in accordance with Section 1000 of the NCDOT "Standard Specifications for Roads and Structures."

3.0 EXECUTION

3.1 The contractor shall be responsible for protecting structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

3.1.1 The contractor shall protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

3.1.2 Obstructions: It shall be the contractor's sole responsibility to conduct exploratory investigations and become thoroughly acquainted with existing conditions and to locate structures and utilities within the project limits in order to avoid conflicts or damage. Where conflicts are unavoidable, the engineer shall be contacted prior to proceeding with construction and all work shall be coordinated with the owner and performed so as to cause no interference with the service rendered by the facility disturbed. All affected utilities shall be notified by the contractor prior to excavation in their vicinity.

3.1.3 The contractor shall provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 Any areas to be filled, graded, or to support pavements or structures shall be cleared and grubbed to remove all topsoil, vegetation, organic matter or other deleterious materials to the satisfaction of the owner's geotechnical engineer at the contractor's expense. All waste materials resulting from clearing and grubbing operations shall be disposed of off the owner's property at the contractor's expense.

3.3 When, in the opinion of the Owner's geotechnical engineer and the engineer, undercut excavation is required, the contractor is responsible for notifying the engineer and allowing the engineer adequate time to profile the excavation surfaces prior to and following undercutting operations for use in estimating the volumes of undercut for payment purposes. The contractor shall assist and allow the engineer adequate time to profile the temporary surfaces prior to and following the completion of a given section or area of undercut excavation. The contractor shall be responsible for implementing all necessary safety and security measures as needed to allow temporary undercut surfaces to remain exposed for measurement by the engineer. Payment for undercut excavation will be made on the basis of the engineer's estimated volumes.

3.4 The contractor shall be responsible for achieving the proper moisture content in all materials to be used for fill, borrow material or backfill. The contractor shall uniformly moisten material that is too dry and scarify or otherwise dry material that is too wet before placement and compaction to within 3 percent of optimum moisture content or as required to meet compaction requirements.

3.4.1 Fill or backfill materials shall not be placed on surfaces that are muddy, frozen, or contain frost or ice.

3.5. Proofrolling Existing Subgrades: Any areas to receive fill and any areas that will support buildings, pavements or other structures shall be proofrolled by the contractor using a four wheeled, rubber tired roller as described in Section 260-2 of the NCDOT "Standard Specifications for Roads and Structures," January 2002. The rubber tired roller shall have a minimum loaded weight of 35 tons. The proofroller should make at least four passes over each location, with the last two passes perpendicular to the first two in the presence of the owner's geotechnical engineer. All proofrolling, including but not limited to equipment, shall be provided by the contractor at the contractor's expense. Any areas which, in the opinion of the geotechnical engineer, wave, rut or deflect excessively shall be scarified, excavated, dried or wetted to the proper moisture range and re-compacted and re-proofrolled until satisfactory results are obtained at the contractor's expense. The contractor shall be responsible for coordinating all proofrolling activities with the owner's geotechnical engineer as necessary to insure that the engineer and Owner's geotechnical engineer is on-site to observe all proofrolling activities.

3.6 Existing slopes to receive fill that are steeper than 25% shall be benched prior to beginning placement of fill. Benches shall be cut having a minimum width of approximately 8 feet to 12 feet and a rise between benches no less than 1 vertical foot nor more than 5 vertical

feet. Begin each bench cut at the intersection of the original ground and the vertical side of the previous cut. Place suitable fill on excavated benches in layers not exceeding 8 inches loose thickness and compact as specified herein. All benching of existing slopes shall be performed by the contractor in accordance with the recommendations of the owner's geotechnical engineer at the contractor's expense.

3.7 Fill and Embankment Construction: shall be performed using approved materials spread in successive, approximately horizontal layers of not more than 8 inches in depth, loose measurement, for the full extent of a particular area being filled. Each layer shall be compacted as specified using suitable equipment. The fill surface shall be shaped and sloped to properly drain at all times.

3.7.1 The contractor shall make the necessary provisions and allow time for the owner's geotechnical engineer to periodically test the compaction of the placed fill as construction progresses. Any fill which fails to meet the specified compaction standard shall be removed, replaced with suitable material, re-compacted and re-tested until acceptable results are obtained to the satisfaction of the owner's geotechnical engineer. Any costs associated with replacing fill failing to meet the required compaction requirements shall be paid by the contractor. The contractor shall reimburse the owner for any re-testing costs due to failed compaction testing.

3.7.2 As fill and embankment construction proceeds, the contractor shall periodically proofroll the filled area using a four wheeled, rubber tired roller as described in Section 260-2 of the NCDOT "Standard Specifications for Roads and Structures," January 2002 at intervals requested by the owner's geotechnical engineer. The rubber tired roller shall have a minimum loaded weight of 35 tons. The proofroller should make at least four passes over each location, with the last two passes perpendicular to the first two in the presence of the owner's geotechnical engineer. All proofrolling, including but not limited to equipment, shall be provided by the contractor at the contractor's expense. Any areas which, in the opinion of the owner's geotechnical engineer, wave, rut or deflect excessively shall be scarified, excavated, dried or wetted to the proper moisture range and re-compacted and re-proofrolled until satisfactory results are obtained at the contractor's expense. The contractor shall be responsible for coordinating all proofrolling activities with the owner's geotechnical engineer as necessary to insure that the geotechnical engineer is on-site to observe all proofrolling activities.

3.8 Compaction: All compaction shall be performed by the contractor at the contractor's expense. Unless specifically noted otherwise elsewhere, all fill, backfill, borrow material, subgrade, and other earth materials shall be placed and compacted in individual lifts not exceeding 8 inches in thickness to at least 98% of the standard Proctor maximum dry density as determined by ASTM D 698. Any areas which do not meet the required compaction criteria shall be removed, replaced and re-compacted with suitable material until the required degree of compaction is achieved, to the satisfaction of the owner's geotechnical

engineer, at the contractor's sole expense. The contractor shall reimburse the owner for any re-testing costs due to failed compaction testing.

3.9 Excavations shall be performed by the contractor to the indicated elevations and dimensions within a tolerance of plus or minus 0.10 feet. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, installing services, other construction, and as required by site specific requirements, standards and regulations.

3.9.1 Excavations for Footings and Foundations: Do not disturb the bottom of the excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work. Do not allow the bottom of the excavation to be damaged by rain, frost or any other means.

3.10 Sheeting and Bracing: When required to prevent damage to property, injury to persons, erosion, cave-ins, or excessive excavation limits, the contractor shall install adequate sheeting, bracing, retaining walls, trench boxes, etc. as may be necessary and as required by OSHA and other agencies having jurisdiction and in accordance with accepted standard practice. When the situation arises, sheeting and bracing shall be used as necessary to protect the integrity of the project site. The lower portions of sheeting may be left in place and backfilled provided it is at least 5 feet below finished grade and does not interfere with any construction or future improvements planned for the site. All sheeting, bracing, shoring, retaining walls, trench boxes and other support devices shall be in accordance with OSHA, and all other local, state and national regulations, requirements, guidelines and recommendations and shall be at the contractor's expense. The contractor is solely responsible for all safety and site security in any way related to construction.

3.11 The contractor shall uniformly fine grade all areas to a smooth, even surface, in accordance with the lines, grades and elevations shown on the plans. The graded surface shall be free from unwanted irregular surface changes, ridges, ruts and shall provide a smooth transition between existing adjacent grades and newly graded areas. All grades shall be within 0.1 feet of plan grades for grassed areas and within 0.04 feet of plan grades for paved areas. Regardless, all grassed areas shall be sloped for proper drainage at a minimum slope of 2 percent and all paved areas shall be sloped for proper drainage at a minimum slope of 1 percent. All grading shall be performed by the contractor at the contractor's expense.

3.11.1 All disturbed areas to be grassed shall be prepared by the contractor by fine grading to the proper grades and contours, raked smooth and cleaned of all surface rocks, organics or any other debris, and seeded and mulched as needed to establish a healthy stand of grass to the satisfaction of the engineer and the owner. When required by the plans or necessary to establish grasses and prevent erosion, the contractor shall provide and install temporary excelsior matting anchored in accordance with the manufacturer's instruction and in accordance NCDOT Specification Section 1060-8.

3.12 Excess and Unsuitable Materials: Excess fill, waste, topsoil, unsuitable materials or other materials, whether considered suitable or unsuitable shall become the property of the contractor (unless specifically chosen to remain the owner's property by the owner) and shall be loaded, hauled, unloaded, placed and disposed of at locations, off the owner's property, secured and properly permitted by the contractor, in accordance with all agencies having jurisdiction, at the sole expense of the contractor. Any materials to remain owner's property shall be removed by the contractor undamaged and moved to an on-site location to be specified by the owner. No additional compensation will be made to the contractor for any activity associated with the disposal of waste or excess materials. The resale of excess or waste materials on the project site will not be permitted.

3.13 Borrow: Should there be insufficient suitable materials from the excavations to meet the requirements for fill or backfill material, the contractor shall be responsible for: locating and obtaining a suitable borrow source off the owner's property, providing all testing necessary to locate suitable borrow and insure the selected materials suitability, all permitting, excavating, loading, hauling, unloading, placing, compacting, disposing of waste material and all other work associated with borrow material all at the contractor's sole expense. All borrow material shall meet the provisions of these specifications.

3.14 Rock Excavation: Rock excavation shall performed in accordance with *Section 2090 "Rock Excavation and Blasting*."

3.15 The contractor shall take all measures necessary to keep surface water out of the foundations, excavations and trenches by diking, ditching, or otherwise avoiding it. All the necessary provisions for proper surface drainage, to the satisfaction of the engineer, shall be made by the contractor as needed to prevent any related damage to the project site or other properties. Any damage as a result of surface water shall be satisfactorily repaired at the contractor's expense.

3.16 Dewatering: All construction shall be performed in dry excavations. All dewatering activities necessary to achieve dry conditions are to be performed by the contractor at the contractor's expense. Groundwater tables shall be maintained by the contractor at levels lower than 2 feet below foundation or structure bearing elevations, pavement subgrade elevations, or pipe invert elevations.

3.16.1 Excavations may be dewatered by using one or more of the following methods: well point system; sumps with pumps or other method(s) as approved by the engineer. Dewatering systems shall be utilized in accordance with good standard practice and must be efficient enough to lower the water level in advance of the excavation and maintain it continuously to keep the excavation bottom and sides firm and dry. Discharge from dewatering shall be disposed of in such a manner that it will not interfere with normal drainage of the area in which the work is being performed, create a public nuisance, cause ponding or cause erosion or sedimentation concerns or problems.

3.16.2 All dewatering discharges shall be in accordance with applicable NC Stormwater General Permits and any other applicable regulations. The operations shall not cause injury to any portion of the work completed, or in progress, or to the surface of roads, or to any public or private properties. Dewatering method(s) and schedules shall be acceptable to all regulatory agencies having jurisdiction. Where private or public properties outside the construction limits will be involved, advance permission and coordination shall be obtained by the contractor.

4.0 METHOD OF MEASUREMENT & BASIS OF PAYMENT

4.1 All work, materials, equipment, labor, testing, incidentals and appurtenances described in this section, with the exception of Undercut, as defined herein, and Rock Excavation, as defined in Section 2090, shall not be measured and paid for as such but shall all be treated as incidental work. The contractor is responsible for including the price of all work covered herein in the prices stipulated for related work in the bid form.

4.2 Undercut Excavation with Soil or Stone Backfill: shall include the work as described herein and related portions of the Contract Documents. The contractor shall be paid for undercut excavation with stone backfill in quantities approved by the engineer at the unit bid price stipulated in the contract for the actual quantities of undercut.

4.3 Rock Excavation: see specification Section 02090.

END OF SECTION 02200

SECTION 02210
EXCAVATION, TRENCHING & BACKFILLING FOR UTILITIES

1.0 GENERAL

1.1 Description: The Contractor shall furnish all materials, labor, equipment, supplies and incidentals necessary to complete the proposed utility work, including but not limited to water lines, fire sprinkler lines, sewer lines, pumping stations and related work, water and sewer service lines, storm drains, storm drainage structures, culverts, casing pipes, sleeves and other utilities to the satisfaction of the engineer and as shown on the plans, specified herein and as specified in related sections.

1.2 The owner may, at their discretion, obtain the services of a licensed geotechnical consultant, at the owner's expense, to sample and test soil parameters and perform compaction density testing of soils, fill, backfill, subgrade and base materials as required by the engineer and stipulated herein. A licensed geotechnical engineer shall be any qualified agency having a NC professional soils engineer on staff, experienced in soil mechanics, testing and soils science and having the necessary staff and properly calibrated equipment to accurately test soil compaction density and the necessary related parameters. The owner's geotechnical consultant shall have the authority to approve or disapprove earthwork on the basis of compliance with project specific requirements and parameters. Any work that does not comply with project requirements, shall be repaired, replaced or otherwise corrected by the contractor at the contractor's expense, to the satisfaction of the engineer and owner's geotechnical engineer. All costs associated with retesting due to non-compliant work shall be paid for by the contractor until such time the geotechnical consultant is satisfied that the work has been corrected.

1.3 Rock Excavation shall be in accordance with Section 02090, Rock Excavation & Blasting, as specified herein and as specified in related sections of the specifications. Rock Excavation shall be defined and performed in accordance with *Section 02090, Rock Excavation.*

1.4 General grading and sitework shall also be in accordance with Section 02200, Earthwork, and as specified herein and as specified in related sections of the specifications.

1.5 All work shall be in strict accordance with the provisions, rules and regulations of the North Carolina Department of Environment and Natural Resources and all other local, state and national agencies having jurisdiction.

1.6 The contractor shall be responsible for all job site safety and security including, but not limited to, work zone traffic control and signing. The contractor shall provide and maintain adequate work zone traffic control in accordance the latest editions of the NCDOT "Standard Specifications for Roads and Structures," the NCDOT "Roadway Standard Drawings" the "Manual of Uniform Traffic Control Devices" by the Federal Highway Administration and all site specific conditions imposed by the NCDOT local Division Office.

1.7 The contractor shall be responsible for coordinating all construction with the owner and other all utility companies affected by the project. Except in an emergency, the contractor shall not operate any controls on any existing utility system without prior approval of the utility owner.

1.8 The contractor will be solely responsible for making investigations and determining the existence, exact locations, sizes, and material types of all existing utilities that may be affected by project activities prior to commencing construction. All existing utilities and related facilities are not shown on the plans and the locations shown on the plans may have been approximated. Any damage incurred to existing utilities, whether shown on the plans, not shown on the plans or incorrectly shown on the plans is the responsibility of the contractor and shall be repaired to the original or better condition, to the satisfaction of the utility owner and engineer, at the sole expense of the contractor.

1.9 Connections to existing utilities shall be made when shown on the plans, required to successfully complete the project and as directed by the engineer. The connections shall be made at times most convenient to the public and when the service will be the least endangered by the work. The connections shall be made on weekends, at night, and on holidays if required by the utility owner or engineer. Should the position of any pole, pipe, conduit, conductor or other structure be such that its removal and/or adjustment is necessary to complete construction, such change will be done by the owner of the obstructions at the contractor's expense.

1.10 Water lines shall be located at least 10 feet laterally from sanitary sewers, unless local conditions or barriers prevent a 10 foot separation, in which case the water main is laid in a separate trench, with the elevation of the bottom of the water pipe at least 18 inches above the top of the sanitary sewer pipe. When a water line crosses a sanitary sewer line, the water line shall be laid at such an elevation that the bottom of the water pipe is at least 18 inches above the top of the sanitary sewer, unless local conditions or barriers prevent an 18 inch vertical separation, in which case both the water line and the sanitary sewer line shall be constructed of Cl. 51 ductile iron pipe (DIP) with joints that are equivalent to AWWA water main standards for a distance of 10 feet on each side of the point crossing.

1.11 During the progress of the work, sidewalks and crossings shall be kept open for the passage of pedestrians. Unless otherwise authorized, drives, roads and streets shall not be obstructed; and unless the engineer authorizes the complete closing of a drive, road or street, the contractor shall take such measures as may be necessary to keep the street open for traffic.

1.11.1 The contractor shall construct and maintain adequate and approved temporary walkways, roads and bridges over excavations and disturbed areas as may be necessary for the purpose of accommodating pedestrians or vehicles to the satisfaction of the engineer. This shall include the contractor providing, installing and maintaining temporary gravel surfaces at his expense in a condition acceptable to the engineer.

1.11.2 When open cut installation is allowed across a drive, road or street and traffic is to be maintained, the installation shall be done in sections so that half the width of the roadway will be available to traffic. The Contractor shall provide all traffic control measures necessary to provide for safe traffic passage.

2.0 MATERIALS

2.1 The contractor shall be responsible for insuring that all construction materials are loaded, unloaded, stockpiled, hauled, distributed, covered, protected, installed and otherwise handled in a manner that will prevent breakage, weather damage or other damage thereto their quality or usefulness and which will insure delivery and installation in a sound and acceptable condition.

2.2 Pipe, fittings and other materials for use in constructing utilities shall be in accordance with the plans and other related sections of these specifications.

2.3 Backfill, Fill and Borrow Materials: used in utility construction shall be excavated, loaded, hauled, unloaded, placed and compacted by the contractor as necessary for the proper completion of the project. All material shall be clean material, free of vegetation, organic matter, rocks larger than 2 inches in any dimension or other deleterious materials. The contractor shall be responsible for drying and/or wetting backfill and fill materials if necessary to achieve specified compaction criteria. If available and suitable, materials may be used from onsite excavation or shall be imported borrow material if not available onsite. Imported borrow material shall be provided as needed by the contractor, at his expense, as necessary for the proper completion of the project to the satisfaction of the engineer. When borrow material is needed, the contractor shall be responsible for obtaining a suitable borrow source, having all borrow sources considered tested for suitability by a qualified soils laboratory, excavating, hauling, placing and compacting the material all at the contractor's sole expense. Backfill, fill and borrow materials shall be in accordance with the following:

2.3.1 Suitable Materials For Backfill And Fill: shall be classified as A-1, A-3 or A-2-4 in accordance with AASHTO Designation M-145 and shall be free from vegetation, organic material and rocks larger than 2 inches. Not more than 12 percent by weight of fill material shall pass the No. 200 sieve. All Backfill and Fill materials shall have a minimum, in place, compacted unit weight of 95 pounds per cubic foot.

2.3.2 Suitable Materials to be Placed in Areas having Groundwater or Wet Conditions: shall be NCDOT #57 washed stone or materials classified as A-1 or A-3 in accordance with AASHTO Designation M-145.

2.3.3 Unsuitable Material: which shall not be allowed for us as backfill or fill material are materials classified as A-2-5, A-2-6, A-2-7, A-4, A-5, A-5, A-7 and A-8 in accordance with AASHTO Designation M 145 or any soils containing organic material, or any soils containing rocks or stones larger than 3 inches in any dimension, or any soils containing other materials

objectionable to the engineer or any soils which cannot be compacted to specified percentage of maximum density given site specific moisture conditions.

2.3.4 Topsoil, unsuitable materials or any material containing organic or other objectionable materials shall not be incorporated into fill or backfill. Clean topsoil, free of roots, rocks, stones and debris, may be stockpiled at an approved location and used as a 4" topdressing to the finished grades specified in areas to be grassed. Any topsoil, unsuitable material or excess material which is not incorporated into the work shall be considered waste material and shall be removed and properly disposed of offsite by the contractor at the contractor's sole expense. Any borrow, fill or other material necessary as a result of topsoil or other material removal from the project site shall be obtained, permitted, hauled, placed, compacted, graded and otherwise completed to the engineer's satisfaction by the contractor at the contractor's sole expense. No additional payment or compensation will be made to the contractor as a result of, or related to topsoil or other unsuitable materials regardless of site conditions or depths and limits encountered.

2.3.5 Any and all excess or unsuitable materials shall be removed, hauled and disposed of off the project site, in accordance with applicable regulations, all at the contractor's sole expense.

2.4 Crusher Screenings: where specified as a select material shall be a fine aggregate material consisting of crushed stone screenings (washed or unwashed) meeting the following gradations:

Sieve	% Passing
3/8 in.	100
#4	80 - 100
#10	65 - 95
#40	25 - 55
#200	0 - 20

2.5 Washed Stone: shall be a coarse aggregate material meeting the gradation requirements of NCDOT standard size No. 57 as specified in Section 1005 of the NCDOT "Standard Specifications for Roads and Structures."

2.6 Concrete: Unless specified otherwise on the plans or other sections of these specifications , all concrete and grouts shall be Portland cement concrete having a minimum compressive strength of 4,000 psi at 28 days. All concrete exposed to weather shall be air entrained. Concrete shall be NCDOT Class A in accordance with Section 1000 of the NCDOT "Standard Specifications for Roads and Structures."

3.0 EXECUTION

3.1 Compaction: All compaction shall be performed by the contractor at the contractor's expense. Unless specified otherwise on the plans or in other sections of these specifications, all backfill, fill, bedding and select materials shall be placed and compacted in individual lifts not exceeding 6 inches in thickness to a minimum 100% standard proctor density under all roads,

drives, parking areas and structures and to a minimum 98% standard proctor density at all other locations as determined by ASTM methods. Any areas which do not meet the required compaction criteria shall be removed, replaced and re-compacted with suitable material until the required degree of compaction is achieved, to the satisfaction of the engineer, at the contractor's sole expense.

3.2 Trenching: The maximum amount of open trench permitted in any one location shall be the length necessary to accommodate the amount of pipe installed in a single day or 500 feet whichever is less. All trenches shall be fully backfilled at the end of each day. Barricades, warning lights, signs, flagmen and other incidentals meeting NCDOT, OSHA and all other applicable requirements shall be provided and maintained.

3.2.1 The maximum width of trench, measured at the top of the pipe, shall not exceed the outside pipe diameter plus two feet, unless otherwise shown on the drawing details or approved by the engineer.

3.2.2 Trench grade for utilities in rock or other non-cushioning material shall be defined as six inches below the outside of the bottom of the utility, which six inches shall be backfilled with extra utility bedding material. Excavation below trench grade that is done in error shall be backfilled to trench grade with stone or other suitable granular material and compacted.

3.2.3 Utility Bedding: The bottom of the trench shall be shaped to provide a firm bedding for the utility pipe. The utility shall be firmly bedded in undisturbed firm soil which is hand-shaped to the pipe, bells and fittings to fully contact all surfaces and properly support the pipe. The bedding shall be shaped so that the pipe will be in continuous contact therewith for its full length and shall provide a minimum bottom segment support for the pipe equal to springline of the pipe or one-half of the outside diameter of the barrel. Special bedding may be required, due to rock excavation, groundwater, depth of cover, impact loadings, or any other conditions as shown on the plans or specified in related sections of specifications. Any type of special bedding required, such as washed stone, crusher screenings or other borrow materials, shall be obtained, hauled, placed and compacted by the contractor at his sole expense as necessary for the proper completion of the project to the satisfaction of the engineer.

3.2.4 Unsuitable Material Below Trench Grade: Soil unsuitable for a proper foundation which is encountered at or below trench grade, such as muck or other deleterious material, shall be removed for the full width of the trench and to the depth required to reach suitable foundation material, or otherwise stabilized to the satisfaction of the engineer using stone or other approved special bedding materials and methods. When rock or wet conditions are encountered at trench bottom grade, the contractor shall, at a minimum, extend excavation to 6 inches below the outside bottom of the utility and install NCDOT #57 washed stone bedding to a depth of 6 inches below the pipe and up to the springline of the pipe for the full trench width or to additional depths if necessary to achieve stable conditions. The contractor shall undercut, remove and replace unsuitable materials below trench grade with washed stone or otherwise satisfactorily stabilize foundation materials regardless of depth or materials needed at the contractor's sole

expense. No additional compensation will be made for additional undercut excavation, disposal of waste materials, stone bedding, other materials, labor or incidentals necessary to achieve stabilized foundation conditions for utility installation.

3.3 Sheeting and Bracing: In order to prevent damage to property, injury to persons, erosion, cave-ins, or excessive trench widths, adequate sheeting and bracing and trench boxes shall be provided, as required by OSHA and other agencies having jurisdiction and in accordance with accepted standard practice. When the situation arises, sheeting and bracing shall be used as necessary to protect the integrity of the road shoulder. Sheeting shall be removed when the trench has been backfilled to at least one-half its depth, or when removal would not endanger the construction of adjacent structures. When required, to eliminate excessive trench width or other damage, sheeting, bracing, or shoring shall be left in place and the top cut off at an elevation of 5.0 feet below finished grade or 1.0 foot above the top of the pipe, whichever is less, unless otherwise directed. All sheeting and bracing and trench boxes will be in accordance with OSHA, and all other local, state and national regulations, requirements, guidelines and recommendations. The contractor is solely responsible for all safety and site security in any way related to construction. All costs associated with sheeting and bracing will be at the contractor's sole expense.

3.4 Excavated Material: Suitable material to be used for backfill shall be neatly and safely deposited at the sides of the trenches where space is available. Whenever possible, excavated material near a roadway should be deposited on the right-of-way side of the trench away from the travel lanes. Where stockpiling of excavated material is required, the contractor shall be responsible for obtaining the sites to be used and shall maintain the operation as needed to prevent erosion and not present an objectionable appearance. The contractor shall be responsible for transporting the material to and from the stockpile area at his expense. All sites shall be restored to the engineer's satisfaction after the stockpiled material is removed. No excavated activities shall be conducted in a manner which impedes the drainage of road ditches, pipes, culverts or other storm drainage routes.

3.5 Excess and Unsuitable Materials : Excess fill, waste or other materials, whether considered suitable or unsuitable shall be the property of the Contractor and shall be loaded, hauled, unloaded, placed and disposed of at locations secured and properly permitted by the contractor, in accordance with all agencies having jurisdiction, at the sole expense of the contractor. No additional compensation will be made to the contractor for any activity associated with the disposal of waste or excess materials. The resale of excess or waste materials on the project site will not be permitted.

3.6 Borrow: Should there be insufficient suitable materials from the excavations to meet the requirements for fill or backfill material, the contractor shall be responsible for: locating and obtaining a suitable borrow, providing all testing necessary to locate suitable borrow and insure the selected materials suitability, excavating, loading, hauling, unloading, placing, compacting, disposing of waste material and all other work associated with borrow material all at the contractor's sole expense. All borrow material shall meet the provisions of these specifications.

3.7 Rock Excavation: Rock excavation shall be performed in accordance with Section 02090 "Rock Excavation and Blasting."

3.8 The Contractor shall take all measures necessary to keep surface water out of the foundations and trenches by diking, ditching, or otherwise avoiding it. All the necessary provisions for proper surface drainage, to the satisfaction of the engineer, shall be made by the contractor.

3.9 Dewatering: All utility installation shall be performed in dry trenches and excavations. All dewatering activities necessary to achieve dry trench conditions are to be performed by the contractor at the contractor's expense.

3.9.1 Trench excavations may be dewatered by using one or more of the following methods: well point system; sumps with pumps or other method(s) as approved by the Engineer. Dewatering systems shall be utilized in accordance with good standard practice and must be efficient enough to lower the water level in advance of the excavation and maintain it continuously to keep the trench bottom and sides firm and dry. If the material encountered at trench grade is suitable for the passage of water without destroying the sides or utility foundation of the trench, sumps may be provided at intervals at the side of the main trench excavation, with pumps used to lower the water level by taking their suction from said sumps. Discharge from dewatering shall be disposed of in such a manner that it will not interfere with normal drainage of the area in which the work is being performed, create a public nuisance, cause ponding or cause erosion or sedimentation concerns or problems.

3.9.2 All dewatering discharges shall be in accordance with applicable NC Stormwater General Permits and any other applicable regulations. The operations shall not cause injury to any portion of the work completed, or in progress, or to the surface of roads, or to any public or private properties. Dewatering method(s) and schedules shall be acceptable to all regulatory agencies having jurisdiction. Where downstream private or public properties outside the construction limits will be involved, advance permission and coordination shall be obtained by the contractor.

3.10 Obstructions: It shall be the contractor's sole responsibility to conduct exploratory investigations and thoroughly acquaint himself with existing conditions and to locate structures and utilities along the proposed utility alignment in order to avoid conflicts or damage. Where conflicts are unavoidable, the engineer shall be contacted prior to proceeding with construction and all work shall be coordinated with the facility owner and performed so as to cause no interference with the service rendered by the facility disturbed. All affected utilities shall be notified by the contractor prior to excavation in their vicinity.

3.11 Backfill material shall be clean, granular earth fill composed of sand, clay and sand, sand and fine gravel, NCDOT #57 washed stone, crusher screenings, or a combination thereof approved by the engineer.

3.11.1 The initial fill from the trench bottom grade or below the trench bottom if unstable conditions are encountered, shall be as shown on the plans and specified herein. All material below the pipe and backfill material to 12 inches above the pipe shall be granular material unless washed stone, crusher screenings or other specified bedding material is shown on the plans. The initial fill shall be carefully placed and tamped around the lower half (springline) of the utility. Backfilling shall be carefully continued until the fill is 12 inches above the top of the utility in layers not exceeding 6 inches (uncompacted thickness), using the best available material from the excavation, if approved by the engineer, or special bedding material if required. The initial fill to an elevation of 12 inches above the pipe shall be free of any rocks or stones having any dimension greater than 1 inch. The initial fill material shall be lowered to within two feet above the top of pipes before it is allowed to fall, unless the material is placed with approved devices that protect the pipes from impact.

3.11.2 The remainder of the trench, above initial backfill and below the subgrade, shall be backfilled and compacted in layers not exceeding 8 inches (uncompacted thickness) per lift using approved material as specified herein.

3.12 All road shoulders and grassed areas shall be: fine graded; raked smooth and cleaned of any rocks, organics or other debris; seeded and mulched and have a healthy stand of grass established; restored to provide proper drainage; restored to the satisfaction of the engineer and all agencies having jurisdiction.

3.13 The specified compaction shall be accomplished using accepted standard methods (powered tampers, vibrators, etc.), with the exception that the first 12 inches of backfilling over the pipe shall be compacted by hand-operated tamping devices. Flooding or puddling with water to consolidate backfill will not be acceptable under any circumstances.

3.13.1 The contractor shall be responsible for coordinating all compaction density testing with the owner's geotechnical consultant. The owner's geotechnical consultant and engineer will select the locations and depths of density tests to be performed as the technician as testing operation progress. The contractor is responsible for having excavation equipment onsite and excavating to the depths and locations specified by the engineer for density tests. The contractor is responsible for re-filling and compacting test holes to the specified level of compaction. As a general rule, one density test will be made for approximately every 250 feet utility trench and at least one test location will be selected under each pavement surface that has been cut. The owner is not required to provide testing for the contractor and the absence of testing in no way relieves the contractor's responsibility to meet compaction requirements at all locations throughout the project as specified.

3.13.2 If any compaction density test results are unsatisfactory, the contractor shall re-excavate, replace (if necessary) and recompact the backfill, and retest, all at the contractor's expense until the desired compaction is obtained. Additional "side" compaction tests shall be made to each side of an unsatisfactory test, as directed by the engineer, to determine the extent of re-

excavation, fill replacement and re-compaction necessary. The owner shall be reimbursed for all failed compaction tests, "side" compaction tests and all costs associated with re-testing.

4.0 METHOD OF MEASUREMENT & BASIS OF PAYMENT

4.1 All work, materials, equipment, labor, testing, incidentals and appurtenances described in this section shall not be measured and paid for as such but shall all be treated as incidental work. The contractor is responsible for including the price of all work covered herein in the prices stipulated for related work in the bid form.

END OF SECTION 02210

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SECTION 02370
EROSION & SEDIMENTATION CONTROL

1.0 GENERAL

1.1 Description: The Contractor shall furnish all materials, labor, equipment, supplies, maintenance and incidentals necessary to prevent erosion and sedimentation in accordance with all local, state and federal standards.

1.2 It shall be the contractor's sole responsibility to install and maintain erosion control measures that perform adequately to prevent erosion or loss of sediment to streams, areas outside the construction limits or adjacent properties to the satifaction of agencies having jurisdiction and the engineer. This may require that the contractor install and maintain additional erosion control measures that are not shown on the plans. Any erosion and sediment control and related work necessary, including repair work, shall be performed by the contractor at the contractor's expense.

1.2.1 The contractor shall be soley responsible for fully complying with the NC Department of Environmental Quality (NCDEQ) Erosion Control Self Inspection including keeping detailed Self Inspection Reports in strict compliance with NCDENR requirements. Fully and properly completed and signed, printed copies of all self inspection reports shall be provided to the owner and architect when requested by either party.

1.3 It is the contractor's responsibility to insure that construction activities comply with NC Stormwater regulations, Jackson County Ordinances and requirements, NPDES permits, The North Carolina Sedimentation Pollution Control Act of 1973, including any subsequent amendments, updates or related requirements under the NC General Statutes or NC Administrative Code. The contractor shall be the party financially responsible for any erosion control, stormwater or NPDES violations and fines related to the contruction of the project.

1.3.1 Upon receipt of notice that a land-disturbing activity is in violation of said act, the contractor shall be responsible for ensuring that all steps or actions necessary to bring the project in compliance with said act are promptly taken.

1.3.2 The contractor is responsible for defending any legal actions instituted pursuant to erosion control.

1.3.3 To the fullest extent permitted by law, the contractor shall indemnify and hold harmless the owner, the engineer and the owner's agents from and against all claims, damages, civil penalties, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from the performance of work or failure of performance of work, provided that any such claim, damage, civil penalty, loss of expense is attributable to a violation of the local, state or federal sedimentation pollution control regulations, laws or acts. Such obligation shall not be construed to negate, abridge or otherwise reduce an other right or obligation of indemnity which would otherwise exist as to any party or persons described in the contract documents.

1.4 Contractor shall take all the necessary measures to prevent any damage to any public or private properties, structures, utilities, facilities, etc. Should any damage occur, the contractor shall be fully responsible for making the necessary repairs or replacements, at the contractor's expense, to the satisfaction of the engineer and owner.

1.5 All work shall be in accordance the "Erosion and Sediment Control Planning & Design Manual," latest edition, by the NC Sediment Control Commission etal and the "Erosion and Sediment Control Field Manual," latest edition, by the NC Department of Environment and Natural Resources except where modified on the plans or by the specifications.

1.6 All disturbed or graded areas shall be grassed (temporary or permanent seeding and mulching) or stabilized with a gravel surface within 7 calendar days.

2.0 MATERIALS

2.1 The contractor shall furnish all materials, equipment, labor and incidentals required to successfully accomplish all work to the satisfaction of the engineer and owner. All materials shall be new and in accordance with the following paragraphs.

2.2 SILT FENCING: shall be as shown on the plans and in accordance with the following:

2.2.1 Steel posts shall be used for silt fencing. Steel posts shall be at least 5 feet in length, approximately 1 3/8 inches wide measured parallel to the fence, and have a minimum weight of 1.33 lb/ft of length. The post shall be equipped with an anchor plate having a minimum area of 14.0 square inches, and shall have a means of retaining wire and fabric in the desired position without displacement. Fence post spacing shall not exceed 6 feet. Fence posts are inclined toward the runoff source at an angle of 15° to 20° from vertical and shall be driven into the ground for a minimum of 24" and properly secured.

2.2.2 Woven wire fence used for silt fencing shall be at least 32 inches high, and shall have a maximum mesh opening of 6 inches. The top and bottom horizontal wires shall be at least 12 gauge or heavier. All other wires shall be at the least 14 gauge or heavier.

2.2.3 Filter fabric used for silt fencing shall consist of a NCDOT Class B synthetic filter fabric, properly secured to the upslope of the wire mesh with wire ties or plastic zip ties.

2.2.4 The height of the installed silt fencing filter fabric shall be 24 inches above the ground surface. A minimum of 12" of the filter fabric shall be properly anchored and buried below grade using either the trench method of the slicing method as shown on the plans.

2.3 STONE FOR EROSION CONTROL: shall be the types and locations shown on the plans and shall be in accordance with Division 10 of the NCDOT Standard Specifications.

2.4 EROSION MATTINGS FOR DITCHES: shall be in accordance with Division 10 of the NCDOT Standard Specifications unless shown otherwise on the plans or described in these specifications.

2.5 EROSION MATTINGS FOR SLOPES: shall be long life, machine produced temporary erosion control blanket of 70% agricultural straw and 30% coconut fiber matrix sandwiched between a polypropylene nettings. Erosion mattings for slopes shall be North American Green SC150 or an approved alternate having equal or better performance characteristic.

3.0 EXECUTION

3.1 The Contractor shall construct and maintain all the necessary erosion control measures as shown on the plans and additional measures as needed to prevent erosion and sedimentation until the project is completed and all disturbed areas have been adequately stabilized by the contractor to the satisfaction of the engineer. Any additional erosion measures or maintenance necessary will be provided by the contractor at no additional cost to the owner.

3.2 All erosion mattings shall be properly installed and anchored using anchoring systems obtained from the manufacturer in accordance with the manufacturer's instructions.

3.3 The contractor shall inspect all erosion measures after every rainfall event and shall remove and dispose of silt accumulations in an approved manner and in accordance with applicable regulations. Erosion control measures shall be rebuilt or removed and replaced whenever they have deteriorated or clogged to such extent that, in the opinion of the engineer, their effectiveness has been reduced.

3.4 All temporary erosion and sediment control measures shall remain in place until the site is completely stabilized to the satisfaction of the engineer. The contractor will be responsible for the removal of all temporary erosion and sediment control measures. All temporary measures removed will remain the property of the contractor and shall be disposed of, off the project property, in an approved manner, at the contractor’s expense. Upon removal of temporary erosion control devices, the contractor shall dress the area to give a pleasing appearance, and shall seed and mulch the area or otherwise provide a stabilized surface to the engineer’s satisfaction.

3.5 All work shall be performed, managed and monitored by the contractor in accordance with all applicable Erosion Control Regulations, NC Stormwater General Permits, site specific Stormwater permits and all other applicable regulations. The contractor's operations shall not cause injury to any portion of the work completed, or in progress, or to the surface of roads, or to any public or private properties. Method(s) and schedules shall be acceptable to all regulatory agencies having jurisdiction. Where private or public properties outside the construction limits will be involved, coordination shall be performed by the contractor, advance permission shall be obtained by the contractor and all applicable permits shall be obtained by the contractor, at the contractor's expense.

4.0 METHOD OF MEASUREMENT & BASIS OF PAYMENT

4.1 There will be no direct payment for any work covered under this specification section. All work, materials, equipment, labor, testing, incidentals and appurtenances described in this section shall not be measured and paid for as such but shall all be treated as incidental work. The contractor is responsible for including the price of all work covered herein in the prices stipulated for related work in the bid form.

END OF SECTION

SECTION 02390
SEEDING & MULCHING

1.0 GENERAL

1.1 Description: The Contractor shall furnish all materials, labor, equipment, supplies, maintenance and incidentals necessary to complete all temporary and permanent seeding, mulching and establishment of grasses in all disturbed areas. The work shall include, but is not limited to, preparation of seedbeds; furnishing, placing, and covering limestone, fertilizer, and seed; compacting seedbeds; furnishing, placing, and securing mulch; mowing; and other operations necessary for the permanent establishment of grasses and legumes from seed on shoulders, slopes, ditches, or any other disturbed areas. When landscape planting plans are provided, the contractor shall install permanent plants and ground cover in accordance with the specific requirements of the landscaping plan.

1.2 All disturbed or graded areas shall be grassed (temporary or permanent seeding and mulching) or otherwise stabilized by an accepted method within 7 calendar days.

1.3 Seeding and mulching shall be performed on all earth areas disturbed by construction and in any other areas within the project limits which previously had unsatisfactory vegetative cover. The contractor shall adapt his operations to variations in weather or soil conditions as necessary for the successful establishment and growth of the grasses.

1.4 The contractor shall install and maintain erosion control measures that perform adequately in accordance with Section 02370 Erosion Control and all applicable laws and regulations.

1.5 Contractor shall take all the necessary measures to prevent any damage to any public or private properties, structures, utilities, facilities, etc. Should any damage occur, the contractor shall be fully responsible for making the necessary repairs or replacements, at the contractor's expense, to the satisfaction of the engineer and owner.

2.0 MATERIALS

2.1 The contractor shall furnish all materials, equipment, labor and incidentals required to successfully accomplish all work to the satisfaction of the engineer and owner. All materials shall be new, in excellent condition and shall be stored and handled in a manner which prevents damage or degradation.

2.2 All materials, including but not limited to, lime, fertilizer, seed, mulch and tack shall be in accordance with material specifications listed in the latest edition of the NC Department of Transportation Standard Specifications for Roads and Structures. Seeding schedules shall be as shown on the plans.

3.0 EXECUTION

3.1 The contractor shall seed, mulch and establish grasses on all disturbed earth areas. The contractor is required to coordinate seeding and mulching operations with all other parties working within the project limits. The contractor will be responsible for repeating seeding and mulching operations and re-establishing grasses if necessary due to failure or neglect in coordinating with others.

3.2 Seeding and mulching shall be performed on a section by section basis immediately upon completion of utility installation, rough grading or other work for a given section. No exception will be made to this requirement unless otherwise permitted in writing by the engineer.

3.3 When construction is ceased for any period of time, the contractor shall temporarily seed, mulch and establish grasses on earth surfaces, overlapping of operations on previously established grassed areas.

3.4 The contractor shall cut and satisfactorily dispose of weeds or other unacceptable growth on the areas to be seeded. Uneven and rough areas outside of the graded section, such as crop rows, farm contours, ditches and ditch spoil banks, fence line and hedgerow soil accumulations, and other minor irregularities which cannot be obliterated by normal seedbed preparation operations, shall be shaped and smoothed as directed by the engineer to provide for more effective seeding and for ease of subsequent mowing operations.

3.4.1 The soil shall then be scarified or otherwise loosened to a depth of not less than 5 inches except as otherwise provided below or otherwise directed by the engineer. Clods shall be broken and the top 2 to 3 inches of soil shall be worked into an acceptable seedbed by the use of soil pulverizers, drags, or harrows; or by other methods approved by the engineer. All rock and debris 2 inches or larger shall be removed from all ground surfaces prior to the application of seed and fertilizer.

3.4.2 On cut slopes that are 2:1 and steeper, both the depth of preparation and the degree of smoothness of the seedbed may be reduced as permitted by the engineer, but in all cases the slope surface shall be scarified, grooved, trenched, or punctured so as to provide pockets, ridges, or trenches in which the seeding materials can lodge.

3.4.3 Seedbed preparation within 2 feet of the edge of any pavement shall be limited to a depth of 2 to 3 inches.

3.4.4 The preparation of seedbeds shall not be done when the soil is frozen, extremely wet, or when the engineer determines that it is an otherwise unfavorable working condition.

3.5 Seasonal limitation for seeding operations; the kinds of grades of fertilizers; the kinds of seed; and the rates of application of limestone, fertilizer, and seed shall be as recommended by the seed supplier and as shown on the plans.

3.5.1 Equipment to be used for the application, covering, or compaction of limestone, fertilizer, and seed shall have been approved by the engineer before being used on the project. Approval may be revoked at any time if equipment is not maintained in satisfactory working condition, or if the equipment operation damages the seed.

3.5.2 Limestone, fertilizer, and seed shall be applied within 24 hours after completion of seedbed preparation unless otherwise permitted by the Engineer, but no limestone or fertilizer shall be distributed and no seed shall be sown when the Engineer determines that weather and soil conditions are unfavorable for such operations.

3.5.3 During the application of fertilizer, adequate precautions shall be taken to prevent damage to traffic, structures, guardrails, traffic control devices, or any other public or private properties. The Contractor shall either provide adequate covering or change methods of application as required to avoid such damage. When such damage occurs the Contractor shall repair it, including any cleaning that may be necessary.

3.6 Limestone may be applied as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, limestone and fertilizer shall be distributed uniformly over the prepared seedbed at the specified rate of application and then harrowed, raked, or otherwise thoroughly worked or mixed into the seedbed.

3.6.1 If liquid fertilizer is used, storage containers for the liquid fertilizer shall be located on the project and shall be equipped for agitation of the liquid prior to its use. The storage containers shall be equipped with approved measuring or metering devices which will enable the engineer to record at any time the amount of liquid that has been removed from the container. Application equipment for liquid fertilizer, other than a hydraulic seeder, shall be calibrated to ensure that the required rate of fertilizer is applied uniformly.

3.7. Seed shall be distributed uniformly over the seedbed at the required rate of application, and immediately harrowed, dragged, raked, or otherwise worked so as to cover the seed with a layer of soil. If 2 kinds of seed are to be used which require different depths of covering, they shall be sown separately.

3.7.1 When a combination seed and fertilizer drill is used, fertilizer may be drilled in with the seed after limestone has been applied and worked into the soil. If 2 kinds of seed are being used which require different depth of covering, the seeding requiring the lighter covering may be sown broadcast or with a special attachment to the drill, or drilled lightly following the initial drilling operation.

3.7.2 When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than 30 minutes prior to application unless otherwise permitted by the engineer.

3.7.3 Immediately after seed has been properly covered the seedbed shall be compacted in the manner and degree approved.

3.7.4 When adverse seeding conditions are encountered due to steepness of slope, height of slope, or soil conditions, the engineer may allow modifications to be made in the above described requirements which pertain to incorporating limestone into the seedbed; covering limestone, seed, and fertilizer; and compaction of the seedbed. Such modifications may include but not be limited to the following:

1) The incorporation of limestone into the seedbed may be omitted on (a) cut slopes steeper than 2:1 (b) on 2:1 cut slopes when a seedbed has been prepared during the excavation of the cut and is still in an acceptable condition; or (c) on areas of slopes where the surface of the area is too rocky to permit the incorporation of the limestone.

2) The rates of application of limestone, fertilizer, and seed on slopes 2:1 or steeper or on rocky surfaces may be reduced or eliminated.

3) Compaction after seeding may be reduced or eliminated on slopes 2:1 or steeper, on rocky surfaces, or on other areas where soil conditions would make compaction undesirable.

Regardless of the modifications allowed, the contractor shall remain fully responsible for the establishment of a healthy, long term growth of grass in all disturbed areas.

3.8. All seeded areas shall be mulched unless otherwise allowed by the engineer.

3.8.1 Grain straw may be used as mulch at any time of the year. If permission to use material other than grain straw is requested by the contractor and the use of such material is approved by the engineer, the seasonal limitations, the methods and rates of application, the type of binding material, or other conditions governing the use of such material will be established by the engineer at the time of approval.

3.8.2 Mulch shall be immediately applied after completion of seeding unless otherwise permitted by the engineer. Care shall be exercised to prevent displacement of soil or seed or other damage to the seeded area during the mulching operations.

3.8.3 Mulch shall be uniformly spread by hand or by approved mechanical spreaders or blowers which will provide an acceptable application. An acceptable application will be that which will allow some sunlight to penetrate and air to circulate but also partially shade the ground, reduce erosion, and conserve soil moisture.

3.8.4 Mulch shall be held in place by applying a sufficient amount of asphalt or other approved binding material to assure that the mulch is properly held in place. The rate and method of application of binding material shall meet the approval of the engineer. Where the binding

material is not applied directly with the mulch it shall be applied immediately following the mulch application.

3.8.5 During the application of asphalt binding material, or other approved binding materials which may cause damage, adequate precautions shall be taken to prevent damage to traffic, structures, guardrails, traffic control devices, or any other public or private properties. The Contractor shall either provide adequate covering or change methods of application as required to avoid such damage. When such damage occurs the contractor shall repair it, including any cleaning that may be necessary.

3.8.6 The Contractor shall take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water, or other causes and shall promptly remove any blockage to drainage facilities which may occur.

3.9 Areas where seeding and mulching have been performed shall be maintained in a satisfactory condition until final acceptance of the project. Maintenance shall include mowing on a regular basis to the satisfaction of the engineer and owner until such time substantial completion of the project is achieved as determined by the engineer.

3.9.1 Areas of damage or failure to establish healthly, permanent growth of grass, regardless of cause, shall be corrected by being repaired or by being completely redone, at the contractor's expense to the satisfaction of the engineer and owner. Where correction will require extensive seedbed preparation, or where earthwork repairs or complete reshaping are necessary, the contractor shall perform the necessary work at their expense.

4.0 METHOD OF MEASUREMENT & BASIS OF PAYMENT

4.1 All work, materials, equipment, labor, testing, incidentals and appurtenances described in this section shall not be measured and paid for as such but shall all be treated as incidental work. The contractor is responsible for including the price of all work covered herein in the prices stipulated for related work in the bid form.

END OF SECTION

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SECTION 02630
STORM DRAINAGE & INCIDENTALS

1.0 GENERAL

1.1 Description: The contractor shall furnish all materials, labor, equipment, supplies and incidentals necessary to complete all storm drainage piping, underdrains, culverts, structures, inlets and appurtenances as shown on the plans and as required for the successful completion of the project, to the satisfaction of the engineer, and in conformance with applicable regulations.

1.2 All storm drainage materials and workmanship shall be in accordance the NC Department of Transportation (NCDOT) "Standard Specifications for Roads and Structures," dated July 2006 and the "Roadway Standard Drawings," dated July 2006 except as modified by the plans and specifications for this project.

1.3 The contractor will be solely responsible for making investigations and determining the existence, exact locations, sizes, and material types of all existing utilities that may be affected by project activities prior to commencing construction. All existing utilities and related facilities are not shown on the plans and the locations shown on the plans may have been estimated. Any damage incurred to existing utilities, whether shown on the plans, not shown on the plans or incorrectly shown on the plans is the responsibility of the contractor and shall be repaired to the original or better condition, to the satisfaction of the utility owner and engineer, at the sole expense of the contractor.

1.4 The contractor shall be responsible for all job site safety and security including, but not limited to, work zone traffic control and signing. The contractor shall provide and maintain adequate work zone traffic control in accordance the latest editions of the NCDOT "Standard Specifications for Roads and Structures," the NCDOT "Roadway Standard Drawings" the AASHTO "Manual of Uniform Traffic Control Devices" and all site specific conditions imposed by the NCDOT local Division Office.

1.5 UNDERDRAIN: shall include the installation of a network of subsurface drains as detailed on the plans and specified herein at locations depths to be designated during construction by the Owner's geotechnical engineer. The collection piping installed in the underdrain shall be HDPE slotted, smooth interior drainage pipe in accordance with these specifications. Underdrain will be paid for at the stipulated unit price per linear foot and shall include all coordination, stake-out, pipe, tees, wyes, fittings, bends, plugs, joints, adaptors, excavation, stone, filter or engineering fabric, grading, off-site disposal of excess or waste materials, borrow materials, backfill, compaction, connections to structures, incidentals and appurtenances to the satisfaction of the engineer and the Owner's geotechnical engineer. Underdrain will be measured by the engineer along the centerline of the underdrain collection piping through all fittings and bends. The contractor shall schedule the engineer 24 hours in advance to measure installed underdrain prior to

covering the collector piping and shall allow the engineer adequate time to obtain measurements for payment. The contractor shall be paid for installed underdrain at approved locations at the unit price be linear foot stipulated in the contract.

2.0 MATERIALS

2.1 STANDARDS: All materials shall be as specified in the NCDOT "Standard Specifications for Roads and Structures," dated July 2006 and the "Roadway Standard Drawings," dated July 2006 except as modified on the plans and herein.

2.2 SHOP SUBMITTALS: The contractor shall submit to the architect or engineer, catalog cuts and shop submittals for all materials, including but not limited to, pipe, filter fabric, culverts, fittings, structures, frames and grates and incidentals proposed for use on the project. Unless stipulated otherwise in the contract, (6) copies of all shop drawings shall be submitted for review. The engineer's review of shop drawings in no way relieves the contractor of his sole responsibility to insure the suitability of all materials used on the project, including but not limited to dimensions, size, capacity, brand, model, compatibility and any other product or material properties. Any unacceptable or unsuitable materials or products incorporated into the project shall be removed and replaced to the satisfaction of the engineer.

2.3 Storm Drain Pipe, Fittings & Couplings: shall be the types and sizes specified on the plans. All storm drainage pipe, fittings & couplings shall be in accordance with the NCDOT Standard Specifications for Roads and Structures except as modified herein and on the plans.

2.3.1 CMP - Corrugated, Galvanized Steel Pipe: shall be in accordance with AASHTO - M36, 2-2/3" x 1/2" corrugations and shall be hot dipped galvanized and fully bituminous coated in accordance with AASHTO M190. CMP - corrugated, galvanized steel pipe shall have the following minimum steel wall thicknesses exclusive of coatings:

24" and less:	16 gauge
36" through 48":	14 gauge

Coupling bands for C.M.P. shall be a minimum of 10-1/2" in width, hot dipped galvanized, and fully asphalt coated with at least two corrugations matching reformed corrugations on all pipe ends. Coupling bands shall be fastened with minimum two 1/2" high strength galvanized diameter bolts and all couplings shall be made watertight using a neoprene gasket or o-rings. Flared end sections for CMP shall be galvanized steel, AASHTO - M36, matching the minimum gauge thickness specified for the corresponding pipe size.

Aluminized pipe may be used in lieu of fully bituminous coated galvanized pipe. Aluminized pipe must meet or exceed all the requirements for galvanized pipe except that the pipe, fittings, coupling bands and appurtenances must be fabricated from aluminum alloy steel sheet meeting the requirements of AASHTO M274 and NCDOT requirements.

2.3.2 RCP - Reinforced Concrete Pipe: shall be in accordance with ASTM C655 and ASTM C76 Class IV, Wall B with spigot groove type joints. Joints shall be watertight with o-ring rubber gasket in accordance with ASTM C443 and ASTM C361. Precast flared end sections and endwall, where required, shall be as specified on the plans.

2.3.3 HDPE - Heavy Duty Polyethylene Pipe: shall be double walled with exterior corrugations and an integrally formed, smooth interior waterway. HDPE shall be in accordance with AASHTO Type S with annular exterior corrugations and an essentially smooth interior waterway braced circumferentially with circular ribs which are formed simultaneously with an outer wall. Pipe and fittings shall comply with the requirements for test methods for AASHTO Designations M 252 and M294 and shall be made from virgin polyethylene compounds which conform with the applicable latest edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM D3350. The minimum parallel plate stiffness values, when tested in accordance with ASTM D2412 shall be as follows:

4" through 10":	340 kN/m^2
12":	345 kN/m^2
15":	290 kN/m^2
18":	275 kN/m^2

HDPE fittings shall be one piece molded and have equal strength and water tightness characteristics as specified for pipe. Unless specified otherwise, all pipe joints shall be the bell and spigot type. All HDPE joints shall be watertight with an elastomeric gasket meeting the requirements of ASTM F477. Handling and installation of HDPE shall be in accordance with AASHTO Section 30, ASTM Recommended Practice D2321 and as recommended by the manufacturer.

2.4 Structural Steel Plate Culverts & Structures: shall be a complete, integrated system supplied by a single manufacturer with a minimum of 10 years experience in the manufacture and installation of structural plate structures. Structural plate shall be of domestic manufacture in accordance with AASHTO - M167 and ASTM A761. All fasteners shall be galvanized and meet the provisions of ASTM A 449, Type 1 and ASTM A-563.

2.5 Storm Drainage Structures: shall be in accordance with the NC Department of Transportation (NCDOT) "Standard Specifications for Roads and Structures," dated January 2002 and the "Roadway Standard Drawings," dated January 2002 except as modified by the plans and specifications for this project.

2.5.1 Cast in Place Concrete Storm Drainage Structures: shall be in accordance NCDOT requirements for concrete and shall be minimum 4,000 psi compressive strength at 28 days.

2.5.2 PVC Storm Drainage Structures: shall be used only when stipulated on the plans. PVC structures shall be watertight manufactured units specifically designed for the type of drainage inlets and storm drainage pipe specified. PVC structures shall be manufactured in accordance

with ASTM D3034 and ASTM F1336 standards. All PVC Storm drainage structures shall be 18 inches in diameter and have a ductile iron, high flow, inlet grate unless specified otherwise on the plans. PVC structures shall be manufactured from PVC and shall include an integral PVC floor and integral PVC pipe stub spigots suitable for watertight connection to the types of storm drain pipe specified. All PVC structure construction and pipe connections spigots shall be watertight in accordance with ASTM D3212 standards. All PVC structures shall be designed to withstand H-25 wheel loading. All pedestrian grates shall be ductile iron, H-10 load rated in accordance with ASTM A-48-83 class 30B standards.

2.6 Downspout Adaptor Assemblies: Roof downspout connections shall be made using the following assembly unless detailed otherwise on the plans:

1 each - Cast iron downspout adaptor matching downspout size, Neenah R-4927 Series or equal.
1 each - Properly sized cast iron extension matching the downspout adaptor size
1 each - Cast Iron Pipe Long Sweep elbow
1 each - Cast iron to HDPE adaptor, ADS or approved equal

2.7 Stone: for use in bedding all pipe and couplings, and for use as underdrain aggregate and for drainage structure foundation conditioning material shall be NCDOT #57 washed stone.

2.8 Concrete: Unless specified otherwise on the plans or Section 3301 of these specifications, all poured-in-place concrete shall be Portland cement concrete having a minimum compressive strength of 4,000 psi at 28 days. All concrete exposed to weather shall be air entrained. Concrete shall be in accordance with Section 1000 of the NCDOT "Standard Specifications for Roads and Structures."

2.9 Geotextile filter fabric: shall be non-woven, needle punched fabrics specifically designed and manufactured for long term subsurface drainage applications. Geotextile filter fabric shall be Mirafi 140N as manufactured Ten Cate Nicolon or an equal approved by the Engineer. Physical properties of geotextile filter fabric shall meet the requirements listed in the following table.

Property	**Test Method**	**Units**	**Elongation ≥ 50%[1]**
Grab Tensile Strength	ASTM D 4632	N (lbs)	500 (112)
Sewn Seam Strength[2]	ASTM D 4632	N (lbs)	450 (101)
Tear Strength	ASTM D 4533	N (lbs)	180 (40)
Puncture Strength	ASTM D 4833	N (lbs)	180 (40)
Burst Strength	ASTM D 3786	kPa (psi)	950 (138)
Ultraviolet Stability[3]	ASTM D 4355	%	50

[1] A measured in accordance with ASTM D 4632
[2] When sewn seams are required.
[3] After 500 hrs

In addition, filter fabric permittivity and apparent opening size shall be as specified by the Owner's Geotechnical Engineer.

3.0 EXECUTION

3.1 Pipe, structures and appurtenances shall be handled in such a manner as to ensure delivery to the site and installed in a sound, undamaged condition. All materials shall be carefully examined for defects before placing, and any found defective shall not be used. If any defects are found in the lines or in any of their fittings or appurtenances, they shall be replaced to the satisfaction of the engineer. All storm drainage pipe foundation preparation, bedding materials and backfill material, and backfilling methods and procedures shall be in accordance with the recommendations of the pipe manufacturer for site specific conditions of installation.

3.2 For underdrain installation, provide full rolls of geotextile filter fabric as furnished from the manufacturer. Protect against damage and deterioration by storing rolls in a dry place and above ground at all times until placement. Cover rolls and partial rolls until used with a dark protective covering. Geotextiles will be rejected by the engineer if found to be defective, deteriorated or damaged.

3.2.1 Underdrain trench excavation shall be to the limits described by the plans. Excavation shall be performed in a manner so as to prevent large voids from occurring in the sides and bottom of the trench providing a smooth graded surface on both the trench floor and walls that is free of debris.

3.2.2 Underdrain geotextile filter fabric shall be placed loosely with no wrinkles or folds, and with no void spaces between the fabric and the ground surface. Successive sheets of geotextiles shall be overlapped a minimum of 12 inches with the upstream sheet overlapping the downstream sheet unless shown or specified with greater overlap on the plans.

3.2.3 After placing the drainage aggregate in the trench over the geotextile filter fabric, the fabric shall be folded over the top of the backfilled aggregate in a manner to produce a minimum overlap of fabric ends the full trench width. All seams shall be subject to the approval of the engineer.

3.2.4 Should the underdrain filter fabric be damaged during installation or drainage aggregate placement, a geotextile patch shall be placed over the damaged area extending beyond the damaged area a distance of at least 2 feet in all directions unless a larger patch is recommended by the engineer in the field.

3.2.5 Placement of underdrain aggregate should proceed immediately following placement of the geotextile. The geotextile should be covered with a minimum of 18 inches above the trench floor or collector pipe, whichever is greater, of loosely placed aggregate prior to compaction. If a perforated collector pipe is to be installed in the trench, a bedding layer of

drainage aggregate should be placed below the pipe, with the remainder of the aggregate placed to the minimum required construction depth.

3.2.6 The underdrain aggregate should be compacted with vibratory equipment to a minimum of 100 percent Standard AASHTO density unless recommended otherwise by the owner's geotechnical engineer.

3.3 Alignment and grade of the pipe and the location of structures shall be as shown on the plans and as required for a proper installation given site specific jobsite conditions as approved by the engineer. All storm drain piping will be laid to the required lines and grades at the required locations and as needed for a proper installation. The size and grade of storm drains shall be as shown on the plans, unless approved otherwise by the engineer. The contractor shall develop detailed record drawings of structure locations, pipe locations, alignments and grades, and the locations of all roof drains, underdrains and miscellaneous drains including the locations of all fittings, which will be provided to the engineer at project completion but prior to release of final payment.

3.4 Structural Plate shall be installed in strict accordance with the instructions of the structural plate manufacturer. The structure shall be assembled in accordance with the manufacturer's shop drawings and in accordance with the instructions and supervision of the plate arch engineer. All bolts and fasteners shall be properly tightened to the torque range specified by the manufacturer. The structural plate system shall be installed in accordance with AASHTO specifications and all necessary precautions shall be taken during backfilling operations to avoid damage to or deformation of the structure. All backfill material and placement shall meet the approval of the manufacturer.

3.5 Proper equipment, tools, and facilities will be provided and used by the contractor for safe and proper completion of the work. All pipe, structures and incidentals will be carefully lowered into the trench piece-by-piece in such a manner as to prevent damage to the structure, pipe or other material or incidental being installed. All storm drain piping shall be carefully bedded as detailed on the plans. The full length of each section of pipe shall rest solidly upon the pipe bed formed with recesses provided to properly accommodate the pipe and fittings.

3.6 All drainage boxes, inlets and all other structures, whether precast, poured in place or otherwise, shall be installed on a level pad of foundation conditioning material (NCDOT #57 stone) compacted to a minimum of 100% standard density. The pad of foundation conditioning material shall have a minimum compacted thickness of 8 inches and extend at least 12" beyond all sides of the structure unless shown otherwise on the plans.

3.7 All storm drain pipe joints, fittings and connections to structures shall be made watertight by the contractor using NCDOT approved materials unless specifically noted otherwise on the plans. Storm drainage construction shall proceed in a sequence and in a manner which does not pose threats to the owner's property nor any other affected public or private properties.

4.0 METHOD OF MEASUREMENT & BASIS OF PAYMENT

4.1 There will be no direct payment for any work covered under this specification section. All work, materials, equipment, labor, testing, incidentals and appurtenances described in this section shall not be measured and paid for as such but shall all be treated as incidental work. The contractor is responsible for including the price of all work covered herein in the prices stipulated for related work in the bid form.

END OF SECTION

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SECTION 02720
AGGREGATE BASE & GRAVEL SURFACES

1.0 GENERAL

1.1 Description: The Contractor shall furnish all materials, labor, equipment, supplies, testing, maintenance and incidentals necessary to construct either aggregate base course suitable for placement of pavement or gravel surfaces at locations shown on the plans and as required for the successful completion of the project. Aggregate materials shall be hauled, placed, compacted, and shaped to conform to the lines, grades, depths, and typical sections required.

1.2 All materials, methods and workmanship shall be in accordance with the latest editions of the NC Department of Transportation (NCDOT), "Standard Specifications for Roads and Structures" and the "Roadway Standard Drawings" except as modified in these specifications or on the plans.

1.3 Contractor shall take all the necessary measures to prevent any damage to any public or private properties, structures, utilities, facilities, etc. Should any damage occur, the contractor shall be fully responsible for making the necessary repairs or replacements, at the contractor's expense, to the satisfaction of the engineer and owner.

2.0 MATERIALS

2.1 The contractor shall furnish all materials, equipment, labor and incidentals required to successfully accomplish all work to the satisfaction of the engineer and owner. All materials shall be clean and in accordance with the NCDOT standards referenced in paragraph 1.2.

2.2 Aggregate Base Course for as a paving base or as a final surface shall be in accordance Articles 1010-1, 1010-2 and 1010-3 of the NCDOT Standard Specifications for Roads and Structures. Unless specified elsewhere, aggregate shall be Type B in accordance with NCDOT requirements.

3.0 EXECUTION

3.1 The Contractor shall construct aggregate base and gravel surfaces at the required locations and thicknesses indicated on the plans to the satisfaction of the engineer and owner. Improper construction or placement of aggregate base or gravel materials shall be corrected, at the contractor's expense, until satisfactory conditions are achieved. Public and private properties shall be protected from any damage or detriment as a result of aggregate base or gravel surface construction.

3.2 Subgrade for aggregate base course or gravel surfaces shall be prepared, stabilized and made suitable for placement of material in accordance with the requirements of Section 500 of

the NCDOT Standard Specifications of Roads and Structures except as modified herein or indicated on the plans.

3.3 The aggregate material shall be placed on the subgrade with a mechanical spreader capable of placing the material to a uniform loose depth and without segregation except that for areas inaccessible to a mechanical spreader, the aggregate material may be placed by other methods approved by the engineer.

3.4 Where the required compacted thickness of base is 8 inches or less, the base material may be spread and compacted in one layer. Where the required compacted thickness is more than 8 inches, the base material shall be spread and compacted in 2 or more approximately equal layers.

3.5 The minimum compacted thickness of any aggregate base course for pavement placement or aggregate base for use as a final gravel surface shall be 6 inches at all locations unless specifically noted otherwise on the plans.

3.6 Each layer of aggregate material shall have been compacted, tested and approved prior to placing succeeding layers of base material or pavement.

3.7 No aggregate material shall be placed on frozen subgrade or base.

3.8 Aggregate base course which is in place on November 15 shall have been covered with a subsequent layer of pavement structure or with a sand seal. Base course which has been placed between November 16 and March 15 inclusive shall be covered within 7 calendar days with a subsequent layer of pavement structure or with a sand seal. Sand seal shall be applied in accordance with NCDOT standard requirements. The application of the sand seal will in no way relieve the contractor of the responsibility to maintain or repair the damaged base or subgrade, no matter what the cause of damage, at no cost to the owner.

3.9 No traffic shall be allowed on aggregate base course which has been prepared for installation of pavement other than necessary local traffic and that developing from the operation of essential construction equipment. Any defects that develop in the completed base, regardless of cause, shall be repaired at the contractor's expense to a suitable condition.

3.10 The contractor shall utilize methods of handling, hauling, and placing aggregate materials which will minimize segregation and contamination. If segregation occurs, the contractor shall correct or replace the material to the engineer's satisfaction, at the contractor's expense. Aggregate materials which are contaminated with foreign materials shall be removed and replaced by the contractor at no additional cost to the owner. The above requirements will be applicable regardless of the type of aggregate material placed and whether being utilized as a pavement base course or final gravel surface.

3.11 All aggregate materials shall be compacted using steel wheel tandem vibratory rollers which have been specifically designed for the compaction of aggregate materials. The number, weight and type of rollers shall be sufficient to compact the mixture to the required density. Unless specifically shown otherwise on the plans, all aggregate materials used for pavement base course or gravel surfaces shall be compacted to a minimum 100% density based on AASHTO T180 as modified by NCDOT.

3.12 Any waste or excess materials shall be properly disposed of offsite at the contractor's expense.

3.13 The owner may employ a qualified testing agency, at their discretion, to conduct density testing of the compacted aggregate materials to verify that the specified density has been achieved. The density tests will be performed at locations randomly selected by the engineer. Areas of aggregate material which fail to meet the specified compaction requirements shall be scarified, repaired and/or replaced as needed to achieve the required compaction at the contractor's expense. Upon completion of corrective measures, density testing will be re-performed to confirm that the specified density has been achieved. All costs associated with re-testing as a result of inadequate densities will be paid for by the contractor.

4.0 METHOD OF MEASUREMENT & BASIS OF PAYMENT

4.1 All work, materials, equipment, labor, testing, incidentals and appurtenances described in this section shall not be measured and paid for as such but shall all be treated as incidental work. The contractor is responsible for including the price of all work covered herein in the prices stipulated for related work in the bid form.

END OF SECTION 02720

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SECTION 02740
ASPHALT PAVEMENTS

1.0 GENERAL

1.1 Description: The Contractor shall furnish all materials, labor, equipment, supplies, testing, maintenance and incidentals necessary to construct and/or repair asphalt plant mixed bases and surface courses. Placement of asphalt pavements shall be constructed in one or more courses on a properly prepared subgrade and aggregate base as required to properly complete construction to the satisfaction of the engineer.

1.2 All materials, methods and workmanship shall be in accordance with the latest editions of the NC Department of Transportation (NCDOT), "Standard Specifications for Roads and Structures" and the "Roadway Standard Drawings" except as modified in these specifications or on the plans.

1.3 Contractor shall take all the necessary measures to prevent any damage to any public or private properties, structures, utilities, facilities, etc. Should any damage occur, the contractor shall be fully responsible for making the necessary repairs or replacements, at the contractor's expense, to the satisfaction of the engineer and owner.

2.0 MATERIALS

2.1 The contractor shall furnish all materials, equipment, labor and incidentals required to successfully accomplish all work to the satisfaction of the engineer and owner. All materials shall be new and in accordance with the NCDOT standards referenced in paragraph 1.2.

2.2 Prime Coat for use in treating non-asphalt bases beneath asphalt pavements shall be a product selected from the NCDOT's most current list of approved products for prime coat applications.

2.3 Tack Coat for application beneath each layer of asphalt base or surface and at the contact surface of structures will be placed on all surfaces except where a prime coat has been applied. Tack coat material shall be asphalt in accordance with NCDOT Grade RS-1H, Grade CRS-1H, Grade CRS-1, Grade HFMS-1 or Grade CRS-2. Tack coat materials shall not be diluted or mixed with water, solvents, or other materials prior to use.

2.4 Asphalt Cement: shall be in accordance Section 620 of the NCDOT Standard Specifications.

2.5 Non-Strip Additive: shall be in accordance Section 620 of the NCDOT Standard Specifications.

2.6 Coarse Aggregate, fine aggregate, mineral filler, stone screenings and sand shall be in accordance with Division 10 of the NCDOT Standard Specifications.

2.7 Asphalt Base and Surface Courses shall be plant mix composed of a mixture of coarse and fine aggregate, asphalt cement, and mineral filler and other additives when required. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that the resulting mixture meets the grading and physical requirements of the NCDOT master mix formula specified for each particular use. Materials which will not produce a mixture within the full allowable tolerances required by NCDOT specifications will be rejected.

2.7.1 The contractor shall obtain materials from an asphalt plant having a current NCDOT master mix approval for the job mix specified. All mix formulas must have been pre-approved for use by NCDOT, prior to beginning work. The asphalt plant shall have in place a quality control program which is in accordance with Section 609 of the NCDOT Standard Specifications for Roads And Structures. A quality control program is defined as all activities, including mix design, process control inspection, sampling and testing, and necessary adjustments in the process that are related to production of a pavement which meets NCDOT standards and requirements.

2.8 Pavement Marking Materials shall be approved by the NC Department of Transportation and shall be on the most current NC Department of Transportation's "Approved Products List."

3.0 EXECUTION

3.1 The Contractor shall construct asphalt pavements at the required locations of the types and thicknesses indicated on the plans to the satisfaction of the engineer and owner. Improper pavements will be removed, properly disposed of off-site and replaced, at the contractor's expense, until satisfactory results are obtained. Bridge floors, curbs, structures, handrails and all other public and private properties shall be covered as needed to prevent spraying, tracking, splattering or other damage from occurring due to paving operations.

3.2 When requested by the engineer, a prime coat shall be applied to the surface of all non-asphalt base courses. Prime coat will be paid for at the unit price stipulated in the bid form. The surface to be treated must be sufficiently dry and the atmospheric temperature in the shade away from artificial heat is 40°F. or above for plant mix, and 50°F. or above for asphalt surface treatment. Prime coat shall not be applied on a frozen surface or when the weather is foggy or rainy.

3.2.1 The base shall be cleaned of objectionable dust, dirt, clay, and any other deleterious matter prior to placing the prime coat. When directed by the Engineer, the Contractor shall dampen the surface of the base prior to the application of the prime coat.

3.2.2 Prime coat shall be applied by means of a pressure distributor in accordance with NCDOT requirements. Prime coat shall be uniformly applied at a rate from 0.20 to 0.50 gallons per square yard.

3.2.3 The prime coat shall be applied to the full width of the base including the side slopes. After the prime coat has penetrated sufficiently, the contractor shall roll the primed surface until all loose base material is thoroughly bonded. The prime coat shall be allowed to thoroughly penetrate the base. When necessary, the contractor shall apply blotting sand in accordance with NCDOT standards.

3.2.4 The prime coat shall be maintained in an acceptable condition until such time as the pavement is placed. All maintenance and replacement of damaged prime coat shall be provided at the contractor's expense.

3.3 Tack coat shall be applied only when the surface to be treated is sufficiently dry and when the atmospheric temperature is 35°F. or above in the shade away from artificial heat. Tack coat shall not be applied when the weather is foggy or rainy.

3.3.1 The existing asphalt or concrete surface to which tack coat is to be applied shall be cleaned of all dust and foreign material prior to placing the tack coat. The Contractor shall remove grass, dirt, and other materials from the edge of the existing pavement prior to the placement of tack coat.

3.3.2 The Contractor shall provide equipment for heating and applying the asphalt material in accordance with NCDOT requirements.

3.3.3 Tack coat shall be uniformly applied at a rate from 0.02 to 0.05 gallons per square yard.

3.3.4 No more tack coat material shall be applied than can be covered with base, binder, or surface course material the same day. No base or surface mixture shall be deposited thereon until the tack coat has sufficiently cured.

3.3.5 Contact surfaces of headers, curbs, gutters, manholes, vertical faces of old pavements, and all exposed transverse and longitudinal edges of each course shall be painted or sprayed with tack coat before mixture is placed adjacent to such surfaces.

3.3.6 After the tack coat has been applied it shall be protected until it has cured for a sufficient length of time to prevent it from being picked up by traffic.

3.4 Asphalt Surface Treatment (AST) shall be the types specified on the plans and shall be in accordance with all NCDOT specifications and requirements.

3.5 When required by the plans or when, in the opinion of the engineer, required for proper placement of pavements, the contractor shall mill existing asphalt pavements at the proper locations to the proper depths, widths, and typical sections necessary.

3.5.1 Milling also includes removing, transporting, and disposing of the milled material; and cleaning the milled pavement surface at the contractor's expense. The milled material shall

become the property of the contractor and shall be disposed of offsite at the contractor's expense.

3.5.2 Milling equipment shall include a self propelled unit capable of removing the existing asphalt pavement to the depths, widths, and typical sections shown in the plans and in accordance with NCDOT Standard Specifications. Removal of the existing pavements shall be to the depth required by the plans or for proper completion of the work to the engineer's satisfaction. Additional equipment necessary to satisfactorily remove the pavement in the area of manholes, water valves, curb and gutter, and other obstructions shall be provided. The milling equipment shall be equipped with a means of effectively limiting the amount of dust escaping from the removal operation in accordance with all applicable regulations.

3.5.3 The existing pavements shall be milled in a manner which will restore the pavement surface to a uniform longitudinal profile and cross section at the locations and as required for proper completion of the project.

3.5.4 The milling equipment shall be operated in such a manner as to prevent damage to the underlying pavement structure, utilities, drainage facilities, curb and gutter, paved surfaces outside the milled area, and any other appurtenances. The milled pavement surface shall be reasonably smooth and free of excessive scarification marks, gouges, ridges, continuous grooves, or other damage as determined by the engineer. Any leveling or patching required as a result of milling shall be repaired with hot asphalt plant mix to the engineer's satisfaction. The contractor shall coordinate the adjustment of manholes, meter boxes, valve boxes and other structures with the milling operation. The engineer may require remilling of any area exhibiting defects such as laminations or defects.

3.5.5 The milled pavement surface shall be thoroughly cleaned of all loose aggregate particles, dust, and other objectionable material by the use of power brooms, power blowers, power vacuums, or other means.

3.6 Asphalt materials shall be transported from the mixing plant to the point of use in vehicles which have tight, clean, smooth metal beds that have been sprayed with an approved release agent, or other approved material, to prevent the mixture from adhering to the beds. Excess release agent shall be removed prior to loading. Each load of mixture shall be fully covered with a canvas or other suitable material. All covers shall be so constructed and secured as to prevent the entrance of moisture and the rapid loss of temperature.

3.6.1 Asphalt mixture shall be spread and finished to the required grades, cross sections, thicknesses, and widths and to uniform density and texture by a self-contained, power propelled paver. The paver shall be equipped and operated with a fully activated screed plate which is designed to be preheated for the full length whenever necessary. The screed shall be of adequate length to spread and finish the full uniform width travel lane being placed. The use of strike off devices, either mechanically or manually operated, will not be permitted in spreading and finishing the mixture placed in the uniform width travel lane or roadways. The paver shall be equipped with a receiving hopper and an automatically controlled distribution

system which is capable of uniformly maintaining a proper head of material in front of the full length of the screed including screed extensions. The screed unit shall be equipped with a sliding shoe attachment which will form a slope on the edge of the mat to prevent edge raveling when the mixture is compacted. All paving equipment shall be in accordance with the requirements of the NCDOT Standard Specifications.

3.6.2 Coordination of the paving operation and the loading operation shall be adjusted to maintain an adequate amount of asphalt mixture in the paver hopper. The paver hopper shall not be allowed to become empty between loads. Should unevenness of texture, tearing, segregation, or shoving occur during the paving operation due to unsatisfactory methods or equipment, the contractor shall immediately take such action as may be necessary to correct such unsatisfactory work. Throwing back excessive material will not be permitted.

3.6.3 Pavers shall be equipped with a screed control system which will automatically control the longitudinal profile and cross slope of the pavement by the use of either a mobile string line or a fixed string line. The grade sensor shall be positioned at the approximate midpoint of the mobile reference system. The contractor shall furnish and erect the necessary guide lines for the proper completion of paving operations.

3.6.4 When placing adjacent lanes of the final surface course, the paver shall be equipped with a joint matching device which will automatically provide control of the depth of the mixture being placed so that, when compacted, it will match the depth of the existing lane.

3.6.5 The use of pavers for spreading and finishing may be omitted where patching or irregularities and obstacles make their use impractical. In these cases, the contractor shall properly spread, rake, and lute the mixture by hand methods.

3.6.6 Paving operations shall be as continuous as possible. Parking spaces, pull-outs, and other irregular areas shall be paved after the main line roadway has been paved.

3.7 Immediately after the asphalt mixture has been spread, struck off, and surface and edge irregularities adjusted, it shall be thoroughly and uniformly compacted. The degree of compaction required shall be in accordance with the 2002 NCDOT Standard Specifications for Superpave mixes. All Superpave mix types shall be compacted to a minmum 92% of the maximum specific gravity in accordance with AASHTO T 209 and as required by Section 610 of the 2002 NCDOT Standard Specifications.

3.7.1 All surface courses shall be compacted using steel wheel tandem vibratory rollers which have been specifically designed for the compaction of asphalt pavements, except that operation in the vibratory mode will be permitted only during the breakdown rolling phase on all final wearing surfaces 1 inch or greater in thickness. Vibratory rollers shall have variable frequency and amplitude capability. The rollers shall be equipped with controls which automatically disengage the vibration mechanism before the roller stops when being used in the vibratory mode. Rollers used to compact the mixture shall be in good condition, capable

of reversing without backlash. Steel wheel rollers shall be equipped with wetting devices to prevent the mixture from sticking to the roller wheels.

3.7.2 The number and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Pneumatic-tired rollers with 2 tandem axles and smooth tread tires will be permitted for use in intermediate rolling.

3.7.3 Compaction rolling (including both breakdown and intermediate rolling) shall be completed prior to the mixture cooling below a temperature of 185°F. Finish rolling shall be performed to remove roller marks resulting from the compaction rolling operations.

3.7.4 The use of rolling equipment which results in excessive crushing of the aggregate or excessive displacement of the mixture will not be permitted. In areas inaccessible to equipment, the mixture shall be thoroughly compacted by the use of hand tampers or hand operated mechanical tampers.

3.8 The owner shall employ a qualified testing agency to conduct density testing of the compacted asphalt to verify that the specified density has been achieved. The density tests will be performed at locations randomly selected by the engineer. The engineer may select to utilize either nuclear density testing methods or cored sample testing methods.

3.8.1 When cored samples of the compacted pavement are required by either method, they shall be taken from the full depth of the course at locations designated by the engineer. When cored samples have been taken, the contractor shall be responsible for repairing all cored test holes. Hole repair shall included cleaning the inside surfaces of the sample hole, dried and lightly coated with tack coat and new asphalt material shall be immediately placed and compacted by the contractor to conform with the surrounding area. A circular tamp or other device shall be used to achieve compaction.

3.8.2 Unless specified otherwise on the plans, all asphalt pavements, including but not limited to, surface, base and binder courses shall be compacted to a minimum density of 92% (percent) of maximum specific gravity as defined by AASHTO T 209. Areas of pavement which fail to meet the specified compaction requirements shall be removed and replaced to the satisfaction of the engineer and owner at the contractor's expense. Upon completion of corrective measures, density testing will be re-performed to confirm that the specified density has been achieved. All costs associated with re-testing as a result of inadequate pavement densities will be paid for by the contractor.

3.9 The contractor shall furnish, install, remove, repair and replace pavement markings as shown on the plans, as necessary to restore preconstruction conditions or better and as required by the engineer. All pavement markings shall be as shown on the plans, in accordance with NCDOT Standard Specifications for Roads and Structures, in accordance with the NCDOT Roadway Standard Drawings and in accordance with the AASHTO Manual of Uniform Traffic Control Devices.

3.9.1 All pavement markings shall be applied using specially designed pavement marking application equipment in accordance with NCDOT requirements. The application equipment shall be maneuverable and manageable to the extent necessary to form straight lines and true arcs. All pavement marking application equipment shall be kept in proper working condition.

3.9.2 Glass beads shall be applied when required to the surface of pavement markings and shall be applied by an automatic dispenser attached to the marking equipment as required to provide the proper amount of retro-reflectivity and uniformly spread and properly embed the beads over the entire surface of the pavement marking.

3.9.3 Pavement markings shall not be placed when the pavement shows any visible signs of containing moisture, or it is anticipated that damage-causing moisture may occur during the installation and drying periods. Paint shall be applied only when the ambient air temperature and pavement surface temperature is a minimum of 40°F and rising and a maximum of 160°F. Thermoplastic pavement markings shall not be applied on existing pavement surfaces or new concrete pavements unless the ambient air temperature and the temperature of the pavement is 60°F and rising. Thermoplastic pavement markings shall not be applied on asphalt surfaces less than 12 hours old unless the ambient air temperature and the temperature of the pavement is 50°F and rising. Epoxy pavement marking shall not be applied unless the ambient air temperature and the pavement surface temperature is a minimum of 35°F and rising. Cold applied plastic pavement marking shall be installed per manufacturer's specifications.

3.9.4 The Contractor shall premark each installation of pavement marking materials prior to application, except when existing markings are visible. The premarking shall be a guide in placing the pavement markings.

3.9.5 To insure maximum possible adhesion, all pavements upon which new pavement markings are to be placed shall be properly prepared to accept the new pavement markings. The surface preparation shall include but not be limited to, cleaning, sealing and curing compound removal necessary for the markings to adhere to the pavement. All pavements shall be cleaned free of grease, oil, mud, dust, dirt, grass, loose gravel and other deleterious material, prior to the application of the pavement markings. The pavement surface area to be prepared including removal of curing compound shall be a minimum of 2 inches wider than the pavement markings to be placed. All new Portland Cement Concrete pavements which contain curing compound shall have all curing compound and surface laitance removed where long-life pavement markings will be placed. Curing compound removal shall be accomplished by high pressure water, sand or shot blasting methods.

3.9.6 When recommended by the manufacturer, a primer-sealer shall be applied to the area where pavement markings are to be placed. The primer-sealer shall be of the type recommended by the manufacturer of the pavement marking material.

3.9.7 The installed pavement marking material shall have a uniform thickness and smooth surfaced cross-section throughout its entire length. All pavement marking widths and lengths

shall be not less than the dimensions specified in the plans and shall not exceed the dimension by more than 1/2 inch. Pavement marking lines shall be straight or of uniform curvature and shall conform with the tangents, curves, and transitions as indicated on the plans and required for site specific requirements. The finished lines shall have well defined edges and be free of horizontal fluctuations. The lateral deviation of the finished lines shall not exceed 1/2 inch from the proposed location alignment at any point. Any greater deviations shall be sufficient cause for requiring the material to be removed and replaced at no additional cost to the owner.

3.9.8 The contractor shall protect the pavement markings until they are track free. Any markings tracked by a vehicle or otherwise damaged shall be removed by methods acceptable to the engineer and replaced at the contractor's expense. The contractor shall be responsible for removing all pavement marking materials spilled on the road surface by a method acceptable to the engineer.

3.9.9 All pavement marking materials shall be applied to the minimum thicknesses for each particular type required by Division 12 of the NCDOT Standard Specifications.

3.9.10 Pavement markings installed by the contractor which prematurely deteriorate, fail to adhere to the pavement, do not meet dimensional tolerances, lack reflectorization, or are otherwise unsatisfactory, during the life of the project shall be replaced by the contractor at the contractor's expense.

4.0 METHOD OF MEASUREMENT & BASIS OF PAYMENT

4.1 All work, materials, equipment, labor, testing, incidentals and appurtenances described in this section shall not be measured and paid for as such but shall all be treated as incidental work. The contractor is responsible for including the price of all work covered herein in the prices stipulated for related work in the bid form.

END OF SECTION 02740

SECTION 02770
CONCRETE PAVEMENTS, CURBS & SIDEWALKS

1.0 GENERAL

1.1 Description: The Contractor shall furnish all materials, labor, equipment, supplies, testing, maintenance and incidentals necessary to construct and/or repair Portland cement pavements, including but not limited to pavements, sidewalks, curb, curb & gutter and valley gutters. Placement of concrete pavements shall be constructed on properly prepared subgrade and aggregate base as required for proper construction to the satisfaction of the engineer.

1.2 All materials, methods and workmanship shall be in accordance with the latest editions of the NC Department of Transportation (NCDOT), "Standard Specifications for Roads and Structures" and the "Roadway Standard Drawings" except as modified in these specifications or on the plans.

1.3 Contractor shall take all the necessary measures to prevent any damage to any public or private properties, structures, utilities, facilities, etc. Should any damage occur, the contractor shall be fully responsible for making the necessary repairs or replacements, at the contractor's expense, to the satisfaction of the engineer and owner.

2.0 MATERIALS

2.1 The contractor shall furnish all materials, equipment, labor and incidentals required to successfully accomplish all work to the satisfaction of the engineer and owner. All materials shall be new and in accordance with the NCDOT standards referenced in paragraph 1.2.

2.2 Concrete: shall be air entrained and have a minimum compressive strength of 4,000 psi at 28 days unless noted otherwise on the plans. All concrete properties shall be in accordance with NCDOT requirements as specified in the NC Department of Transportation Standard Specifications for Roads and Structures.

2.3 Reinforcing: Deformed grade 60 rebar, ASTM A615 of the sizes & types shown on the plans.

2.4 Welded Wire Fabric: ASTM A185 of the sizes & weights shown on the plans.

2.5 Curing Agents: shall be in accordance with NCDOT Standard Specifications Section 1026.

2.6 Joint Filler: shall be in accordance with NCDOT Standard Specifications Article 1028-1.

2.7 Joint Sealant: shall be in accordance with NCDOT Standard Specifications Article 1028-4.

2.8 Pavement Marking Materials: shall be approved by the NC Department of Transportation and shall be on the most current NC Department of Transportation's "Approved Products List."

3.0 EXECUTION

3.1 The Contractor shall construct concrete pavements at the required locations of the types and thicknesses indicated on the plans to the satisfaction of the engineer and owner. Improper pavements will be removed, properly disposed of off-site and replaced, at the contractor's expense, until satisfactory results are obtained. Bridge floors, curbs, structures, handrails and all other public and private properties shall be covered as needed to prevent splattering or other damage from occurring due to concrete operations.

3.2 The subgrade and aggregate base beneath Portland cement concrete pavement shall be prepared in accordance with NCDOT Standard Specifications. The contractor shall use an approved fine grading machine to produce final subgrade and aggregate base surfaces meeting the lines, grades, and cross sections required by the plans or necessary for the acceptable completion of the work.

3.21 The surface of the aggregate base shall be damp at the time the concrete is placed. The contractor shall sprinkle the base when necessary to provide a damp surface. The contractor shall satisfactorily correct all soft or damaged areas in the subgrade or base prior to placing concrete.

3.2.2 Hauling over the base course will not be allowed except where specifically permitted by the engineer. The engineer may allow equipment dumping concrete to operate on the base to the extent and under the conditions the engineer deems necessary to facilitate placing and spreading the concrete.

3.3 Concrete shall be handled in such a manner as to prevent segregation and kept free from mud, soil, or any other foreign matter.

3.3.1 The contractor is fully responsible for protecting concrete at all times, including but not limited to, the prevention of edge breakage, breakage of unhardened concrete, vandalism and rain or weather damage. Should any damage or detriment occur, the contractor shall replace the damaged concrete at the contractor's expense, to the engineer's satisfaction.

3.3.2 Where finishing operations must be completed after dark, artificial light acceptable to the engineer shall be provided by the contractor.

3.3.3 Paving operations shall not be undertaken or shall be discontinued when any of the following conditions exist:

a) When a descending air temperature in the shade and away from artificial heat reaches 40°F, paving shall be stopped. Paving shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F.
b) When the subgrade or base course is frozen.
c) When aggregates to be used in the mix contain frozen particles.
d) When air temperature in shade is 95°F and rising or the concrete temperature is greater than 95°F.

3.3.4 Where additional pavement must be placed adjacent to new pavement by machine methods, it shall not be placed until the concrete has attained a flexural strength of at least 450 psi. Construction equipment or hauling equipment will not be allowed over the pavement until the concrete has attained a flexural strength of 550 psi.

3.4 Concrete shall be placed using a slip form paver or fixed forms at the contractor's discretion and as required to properly complete the work.

3.4.1 Where a slip form paver is to be used, the concrete shall have sufficient cohesion to prevent appreciable slumping of the pavement edges. When the original mix design produces a concrete which will not meet these requirements, production shall be stopped or slowed and corrections to the mix shall be immediately made.

3.4.2 The slip form paver shall be an approved self-propelled machine(s) designed to spread, consolidate, screed, and float finish the concrete in one complete pass of the machine in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement. The machine shall vibrate the concrete for the full width and depth being placed. The vibration shall be accomplished internally by vibrating tubes or arms working in the concrete or with a vibrating screed or pan operating on the surface of the concrete. The slip form paver shall be equipped with forms of sufficient length and rigidity to adequately support the edges of the slab so as to permit any necessary hand finishing. The slip form paver shall be equipped with and utilize automatic controls for both horizontal and vertical control. These automatic controls shall be checked daily by the contractor and be working properly prior to beginning the days operations.

3.4.3 The slip form paver shall be operated with a continuous forward movement and all operations of mixing, delivering, and spreading the concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If for any reason it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately.

3.4.4 Surface smoothness and texture created by the slip form paver shall meet the requirements of NCDOT Standard Specifications Article 710-6 and Article 710-7 except that a longitudinal straight edge tolerance of 1/4 inch in 10 feet will apply to the area within 6 inches of the edge of pavement. The maximum acceptable edge slump shall be 1/4 inch.

3.4.5 Fixed forms shall be metal and of such section and design that they will adequately support the concrete and the construction equipment.

3.4.6 Fixed forms shall have a depth not less than the edge thickness of the pavement to be constructed and not more than 1 inch greater than the edge thickness of the pavement to be constructed. The base width shall be at least equal to the height of the form.

3.4.7 The top face of the fixed form shall not vary from a true plane more than 1/8 inch in 10 feet, and the upstanding leg shall not vary more than 1/4 inch.

3.4.8 Straight fixed forms 10 feet in length shall have at least 3 pin pockets. Straight forms 5 feet in length shall have at least 2 pin pockets.

3.4.9 Form pins shall be metal and shall be capable of holding the forms rigidly in place during construction operations. The engineer may require pin holes in the base to be sealed prior to placing subsequent pavement.

3.4.10 Fixed form sections shall be connected by a locking joint which shall keep the forms free from vertical and horizontal movement.

3.4.11 Straight fixed forms 10 feet in length shall be used on tangents and on curves having a radius of 200 feet or more. Forms for curves having a radius of between 200 feet and 50 feet may be either straight forms 5 feet in length or flexible forms. Forms for curves having a radius of less than 50 feet shall be flexible forms.

3.4.12 All fixed forms shall be thoroughly cleaned before being set and shall be thoroughly oiled before any concrete is placed. The bearing of the forms shall be checked and all areas of inadequate bearing shall be corrected.

3.4.13 All rejected forms which are not satisfactorily corrected immediately shall be removed from the project by the contractor.

3.4.14 Forms shall be set a sufficient distance in advance of the point where the concrete is being placed to provide for a continuous operation in placing the concrete and for proper inspection of line and grade.

3.5 The concrete shall be spread uniformly over the entire area between the forms without segregation. Spreading shall be done with a mechanical spreader except where hand methods are necessary due to pavement design, equipment breakdown, or other emergency.

3.5.1 After the concrete has been spread it shall be uniformly vibrated. Vibrators for full width vibration of concrete paving slabs may be either the surface pan type or the internal type with either immersed tube or multiple spuds. They may be attached to the spreader or the finishing machine, or may be mounted on the separate carriage. They shall not come in contact with the joint, load transfer devices, subgrade, or side forms. Machine mounted vibrators shall be either stopped or removed from contact with the concrete whenever the forward motion of the machinery is stopped. The frequency of the surface vibrators shall not be less than 3,500 impulses per minute and the frequency of the internal type shall not be less than 5,000 impulses per minute for tube vibrators and not less than 7,000 impulses per minute for spud vibrators.

3.5.2 When spud type internal vibrators, either hand operated or attached to spreaders or finishing machines, are used adjacent to forms, they shall have a frequency of not less than 3,500 impulses per minute.

3.6 Finishing and joints for concrete pavement, curb & gutter, sidewalks or miscellaneous concrete shall be in accordance with Article 710-6, Article 720-7, Article 846-3 or Article 848-3 of the NCDOT Standard Specifications for Roads and Structures as applicable. The final finish shall produce a pavement surface that is true to grade and uniform in appearance and free of irregular, rough, or porous areas. Following the finishing of the pavement by the screed and float and the checking with the straightedges, the surface of the pavement shall be further finished by brooming, burlap dragging, or other acceptable method which will produce a uniform surface texture acceptable to the engineer and owner. Broom and burlap drag finished shall be perpendicular to the direction of traffic unless specifically noted otherwise. Care should be taken in finishing concrete in order to avoid ridges or high places which will prevent water from draining properly. The use of excessive water during the finishing operations will not be permitted.

3.7 Concrete less than 72 hours old which may be subject to damage by freezing shall be adequately protected with insulating materials such as burlap, plastic sheets or other materials as approved by the engineer, until the concrete reaches an age of 72 hours. Concrete damaged as a result of freezing shall be removed and replaced by the contractor at no cost to the owner.

3.7.1 Protective covering which will protect the surface of the freshly placed pavement from rain shall be readily available each day at the location of each proposed day's operation prior to beginning work. Concrete damaged as a result of failure on the part of the contractor to adequately protect the concrete from rain and concrete damaged by improper use of protective covering shall be removed and replaced by the contractor at the contractor's expense.

3.8 Immediately after finishing operations have been completed and surface water has disappeared, all exposed surfaces of the pavement shall be cured by one of the methods covered by this article, unless otherwise approved by the engineer.

3.8.1 The selected curing method shall be applied to the edges of the pavement immediately after the forms are removed. The total curing period required shall not be less than 3 curing days for all methods. A curing day will be considered as any consecutive 24 hour period, beginning when the manipulation of each separate mass has been completed, during which the air temperature adjacent to the mass does not fall below 40°F.

3.8.2 The minimum rate of application of membrane curing compound shall be 1 gallon per 150 square feet when the application equipment is mechanically operated or 1 gallon per 100 square feet when the application equipment is hand operated. Mechanically operated application equipment shall be designed to apply a uniformly agitated continuous flow of the curing compound at the prescribed rate to all concrete surfaces. The membrane curing compound film shall be protected at all times and any damage shall be immediately repaired. The Contractor shall keep available a sufficient amount of polyethylene film, burlap, or other approved material to provide for protection of the concrete during rain or when the application equipment fails to apply the curing compound uniformly to all surfaces.

3.8.3 Sections of polyethylene film shall be spread in a manner which will prevent damage to the finished pavement surface. Lap joints of the sections shall be at least 12 inches wide and suitable precautions shall be taken to prevent the circulation of air beneath the film. The film shall be checked for damage when it is spread and while in use and any damaged sections shall be immediately repaired or replaced.

3.8.4 Sections of burlap shall be spread in a manner which will prevent damage to the finished pavement surface. Lap joints shall be at least 6 inches wide. The amount of burlap to be used shall be not less than 12 ounces per running yard based on a 40 inch width and may be either 1 layer of Class 4 burlap or 2 layers of Class 1, 2, or 3 burlap. The burlap shall be thoroughly saturated prior to placing on the concrete and shall be kept thoroughly wet throughout the curing period.

3.9. Forms shall not be removed from freshly placed concrete until is has hardened sufficiently to resist spalling, cracking, or any other damage, but in no case until at least 24 hours after the concrete has been placed. Any honey-combed areas along the sides or edges of the slab shall be repaired by filling with mortar immediately after the forms have been removed. The mortar shall be a mix of 1 part of cement to 2 parts of fine aggregate.

3.10 All joints shall be constructed in accordance with the requirements of these specifications and the details shown on the plans. All joints shall be sawed or formed and sealed with joint sealer in accordance with the dimensions and details shown on the plans. Joints shall be sealed in accordance with the provisions of Article 700-12 of the NCDOT Standard Specifications for Roads and Structures.

3.10.1 Sawing to the full depth required by the plans to control random cracking shall be done as soon as the concrete has hardened sufficiently to be sawed without spalling and

raveling but not more than 24 hours after the concrete is placed. The additional sawing necessary to provide the full joint width required by the plans shall be done no earlier than 10 days prior to the sealing of the joint.

3.10.2 The engineer may order any concrete pavement or shoulder where uncontrolled cracking has occurred prior to final acceptance to be removed and replaced by the contractor at no additional cost to the owner.

3.10.3 Transverse contraction joints shall be formed or sawn as applicable and constructed in accordance with the details, dimensions and intervals as shown on the plans.

3.10.4 Transverse construction joints shall be constructed by use of an approved form in an approved location whenever the placing of concrete is suspended for more than 30 minutes. When applicable, dowel bars of the size and spacing shown on the plans shall be used.

3.10.5 Transverse expansion joints shall be constructed in accordance with the details shown on the plans utilizing an approved joint assembly or joint filler. All joints shall be sealed with low modulus silicone sealant. Backer material and sealant shall be installed in accordance with the manufacturer's recommendations. Any failure of the joint material will be cause for rejection, and the joint shall be repaired as approved by the engineer at no additional cost to the owner. The concrete shall be at least 14 calendar days old before the joints are sealed. Joint sealer shall not be placed when the air temperature near the joint is less than 45°F. or is 45°F. and falling. The sealer shall be placed to reasonably close conformity with dimensions shown on the plans. Any unreasonable deviation will be cause for rejection. Any surplus joint sealer on the pavement shall be removed to the engineer's satisfaction.

3.10.6 Immediately after sawing the joint to the dimensions as shown on the plans, the resulting slurry shall be completely removed from the joint by flushing with a jet of water under pressure. Sand blasting shall be used to clean joint faces before joints are sealed. As many passes with a sand blaster as are necessary shall be made to provide a clean joint wall. After cleaning, the joint shall be thoroughly dry at the time of sealing. All joints shall be blown clear of deleterious materials with air using a nozzle pressure of at least 90 psi before installing the backer rod. Rotary screw compressors shall be used for this purpose and shall be equipped with properly operating traps capable of removing water and oil from the air.

3.11 Sections of concretes which are removed shall be neatly saw cut with suitable equipment. Sawing to the full depth of the existing concrete will be required without spalling or otherwise damaging the edges to remain. Where removed concretes are to be replaced or repaired, all contact surfaces between the existing concrete and repair concrete shall be completely coated with a suitable bonding agent applied in accordance with the manufacturer's instructions.

3.12 The owner shall engage the services of a qualified testing consultant to test the concrete for adherence to the referenced standards and make test cylinders for compressive

strength tests. Testing and samples will be taken randomly as directed by the engineer. In addition, the engineer may require that cores be taken at random locations to determine whether the thickness meets the requirements designated for the project. Concrete which fails to meet the specified strength and other project requirements shall be removed and replaced to the satisfaction of the engineer and owner at the contractor's expense. Upon completion of corrective measures, testing will be re-performed to confirm that the specified density has been achieved. All costs associated with re-testing as a result of inadequate concrete will be paid for by the contractor.

3.13 The contractor shall furnish, install, remove, repair and replace pavement markings as shown on the plans, as necessary to restore preconstruction conditions or better and as required by the engineer. All pavement markings shall be as shown on the plans, in accordance with NCDOT Standard Specifications for Roads and Structures, in accordance with the NCDOT Roadway Standard Drawings and in accordance with the AASHTO Manual of Uniform Traffic Control Devices.

3.13.1 All pavement markings shall be applied using specially designed pavement marking application equipment in accordance with NCDOT requirements. The application equipment shall be maneuverable and manageable to the extent necessary to form straight lines and true arcs. All pavement marking application equipment shall be kept in proper working condition.

3.13.2 Glass beads shall be applied when required to the surface of pavement markings and shall be applied by an automatic dispenser attached to the marking equipment as required to provide the proper amount of retro-reflectivity and uniformly spread and properly embed the beads over the entire surface of the pavement marking.

3.13.3 Pavement markings shall not be placed when the pavement shows any visible signs of containing moisture, or it is anticipated that damage-causing moisture may occur during the installation and drying periods. Paint shall be applied only when the ambient air temperature and pavement surface temperature is a minimum of 40°F and rising and a maximum of 160°F. Thermoplastic pavement markings shall not be applied on existing pavement surfaces or new concrete pavements unless the ambient air temperature and the temperature of the pavement is 60°F and rising. Thermoplastic pavement markings shall not be applied on asphalt surfaces less than 12 hours old unless the ambient air temperature and the temperature of the pavement is 50°F and rising. Epoxy pavement marking shall not be applied unless the ambient air temperature and the pavement surface temperature is a minimum of 35°F and rising. Cold applied plastic pavement marking shall be installed per manufacturer's specifications.

3.13.4 The Contractor shall premark each installation of pavement marking materials prior to application, except when existing markings are visible. The premarking shall be a guide in placing the pavement markings.

3.13.5 To insure maximum possible adhesion, all pavements upon which new pavement markings are to be placed shall be properly prepared to accept the new pavement markings.

The surface preparation shall include but not be limited to, cleaning, sealing and curing compound removal necessary for the markings to adhere to the pavement. All pavements shall be cleaned free of grease, oil, mud, dust, dirt, grass, loose gravel and other deleterious material, prior to the application of the pavement markings. The pavement surface area to be prepared including removal of curing compound shall be a minimum of 2 inches wider than the pavement markings to be placed. All new Portland Cement Concrete pavements which contain curing compound shall have all curing compound and surface laitance removed where long-life pavement markings will be placed. Curing compound removal shall be accomplished by high pressure water, sand or shot blasting methods.

3.13.6 When recommended by the manufacturer, a primer-sealer shall be applied to the area where pavement markings are to be placed. The primer-sealer shall be of the type recommended by the manufacturer of the pavement marking material.

3.13.7 The installed pavement marking material shall have a uniform thickness and smooth surfaced cross-section throughout its entire length. All pavement marking widths and lengths shall be not less than the dimensions specified in the plans and shall not exceed the dimension by more than 1/2 inch. Pavement marking lines shall be straight or of uniform curvature and shall conform with the tangents, curves, and transitions as indicated on the plans and required for site specific requirements. The finished lines shall have well defined edges and be free of horizontal fluctuations. The lateral deviation of the finished lines shall not exceed 1/2 inch from the proposed location alignment at any point. Any greater deviations shall be sufficient cause for requiring the material to be removed and replaced at no additional cost to the owner.

3.13.8 The contractor shall protect the pavement markings until they are track free. Any markings tracked by a vehicle or otherwise damaged shall be removed by methods acceptable to the engineer and replaced at the contractor's expense. The contractor shall be responsible for removing all pavement marking materials spilled on the road surface by a method acceptable to the engineer.

3.13.9 All pavement marking materials shall be applied to the minimum thicknesses for each particular type required by Division 12 of the NCDOT Standard Specifications.

3.13.10 Pavement markings installed by the contractor which prematurely deteriorate, fail to adhere to the pavement, do not meet dimensional tolerances, lack reflectorization, or are otherwise unsatisfactory, during the life of the project shall be replaced by the contractor at the contractor's expense.

4.0 METHOD OF MEASUREMENT & BASIS OF PAYMENT

4.1 There will be no direct payment for any work covered under this specification section. All work, materials, equipment, labor, testing, incidentals and appurtenances described in this section shall not be measured and paid for as such but shall all be treated as incidental work.

The contractor is responsible for including the price of all work covered herein in the prices stipulated for related work in the bid form.

END OF SECTION

SECTION 02830
SEGMENTAL (MODULAR) RETAINING WALL SYSTEMS

1.0 GENERAL

1.1 Description: The Contractor shall furnish all materials, labor, equipment, supplies, design, testing, maintenance and incidentals necessary and construct modular (also known as segmental or mse walls) retaining wall systems at the locations, elevations and dimensions indicated on the plans. The modular retaining wall system shall consist of geogrid reinforced backfill system, drainage system, and a decorative split face concrete masonry unit facing full height. The manufacturer of the modular retaining wall system shall have been successfully producing retaining walls, including architectural masonry units, geogrid reinforcement, drainage and all related appurtenances for a minimum of 10 years. The modular retaining wall system shall be constructed under the full time supervision of an experienced field superintendent, approved by the wall system manufacturer and installed in strict accordance with the manufacturer's specifications and recommendations. The modular retaining wall system shall be properly constructed to the satisfaction of the engineer and owner.

1.2 The modular retaining wall system shall be in accordance with the requirements outlined herein, the NC Building Code and any additional applicable local, state, national and international codes and regulations whichever has the most stringent requirements. The contractor will be responsible for obtaining any building permits required for wall construction and shall pay any associated fees imposed by the building inspections office.

1.3 At no additional cost to the owner, the retaining wall system to be provided by the contractor shall include complete structural design of the wall system by a qualified, licensed NC Professional Engineer, ("wall engineer") with a minimum of 5 years experience in geogrid reinforced, modular retaining wall design and construction. The design provided by the wall engineer shall include, but shall not be limited to, aggregate and/or concrete foundation system, wall subsurface drainage system, any and all soils testing and evaluations as may be necessary by a qualified geotechnical laboratory (laboratory to be under the supervision of an experienced NC Professional Geotechnical Engineer), geogrid soil reinforcement system including fill materials and placement, reinforcement of all backfill associated with wall construction, fence post installation, design provisions to accommodate surface drainage structures and piping as shown on the plans and all related wall appurtenances. Further, at no additional cost to the owner, the wall engineer shall be responsible for engaging the services of a qualified NC Professional Geotechnical Engineer and associated qualified geotechnical laboratory to provide all necessary geotechnical testing, evaluations, analyses, materials testing and quality control as needed to insure the proper design, construction and completion of the wall system and associated work, to the satisfaction of the wall engineer, as evidenced by the wall engineer's certification of satisfactory completion of the installed wall system.

1.3.1 A minimum factor of safety of 1.5 shall be used as a basis of design by the wall engineer for internal, external and facing stability. The wall engineer shall incorporate an

analysis of global stability in the wall design and shall base the design on a minimum factor of safety of 1.5 for long term global or mass stability. Shop submittals, signed and sealed by the wall engineer, shall list all factors of safety employed by the wall engineer in preparing each wall design.

1.3.2 Where backfilled materials above the wall are shown on the plans at slopes steeper than 2 horizontal to 1 vertical and in locations where backfilled slopes steeper than 2 horizontal to 1 vertical are necessary to accommodate the construction of walls, the wall engineer shall incorporate as an integral part of the wall design, the proper reinforcement of the fill slopes, by employing a properly designed and constructed geogrid soil reinforcement system with the constructed slope having the minimum factor of safety as described in paragraph 1.3.1.

1.3.3 The wall engineer shall submit to the engineer, a letter, bearing the wall engineer's NC Engineer's signature and seal, certifying that the modular retaining wall design meets all requirements of the contract documents, the NC Building Code and all other applicable codes and standards for the specific locations of installation. The wall engineer shall observe wall construction throughout construction as required to submit a signed and sealed certification statement to the engineer stating that the wall was adequately constructed within significant compliance and intent of the design provided by the wall engineer. The wall engineer's certification of construction shall be submitted to and approved by the engineer prior to release of final payment to the contractor and shall state:

> *I, _____ (wall engineer's full name and NC Professional Engineer License Number), having been authorized to periodically observe the construction of Segmental Wall (insert wall number or name) for the Proposed Site Improvements for ELEVATE in Jackson County, NC, do hereby state, that to the best of my knowledge and abilities, Segmental Wall (insert wall number or name), including associated appurtenances, was constructed within significant intent and compliance of the design as submitted, the contract documents for the project, other applicable codes.*

1.4 The contractor shall submit shop submittals for all materials and methods of installation signed and sealed by the wall engineer. Shop drawings submittals shall also include style and color samples of the concrete masonry wall facing for the owner to select the style and color of wall facing. Six (6) copies of all shop submittals shall be submitted to the engineer for review. Materials which have not been approved shall not be delivered for use on the project. The engineer's review of shop drawings in no way relieves the contractor of his sole responsibility to insure the suitability of all materials used on the project, including but not limited to dimensions, size, capacity, brand, model, compatibility and any other product or material properties. Any unacceptable or unsuitable materials or products incorporated into the project shall be removed and replaced to the satisfaction of the engineer.

1.5 All materials, methods and workmanship shall be in accordance with other applicable sections of these specifications and the latest editions of the NC Department of

Transportation (NCDOT), "Standard Specifications for Roads and Structures" whichever is, in the opinion of the engineer, the most stringent , except as modified by the wall engineer.

1.6 Contractor shall take all the necessary measures to prevent any damage to any public or private properties, structures, utilities, facilities, etc. Should any damage occur, the contractor shall be fully responsible for making the necessary repairs or replacements, at the contractor's expense, to the satisfaction of the engineer and owner.

2.0 MATERIALS

2.1 The contractor shall furnish all materials, equipment, labor and incidentals required to successfully accomplish all work to the satisfaction of the engineer and owner. All materials shall be new and in accordance with the wall engineer's and manufacturer's requirements and in accordance with the following.

2.2 All materials shall be delivered on pallets and stored on elevated platforms, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and or other causes. Concrete masonry units shall be banded to pallets and stored in a manner which prevents breaking, chipping, staining or otherwise defacing the units. Units that are damaged or have manufacturer imperfections shall be replaced if objectionable to the engineer or owner.

2.3 A complete integrated, modular retaining wall system shall be provided by one of the following manufacturers or an alternate pre-approved by the engineer:

A. Allan Block Corporation - Edina, MN (corporate headquarters)
B. Keystone Retaining Wall Systems, Inc. (Contech) - Minneapolis, MN (corporate headquarters)
C. MESA Retaining Wall (Tensar Earth Technologies, Inc.) - Atlanta, GA
D. RidgeRock Retaining Walls, Inc. - Charlotte, NC

2.4 Aggregates: shall be clean, well-graded, compactable aggregate in accordance with the wall engineer's specifications and the NCDOT Standard Specifications, latest edition.

2.5 Concrete: shall be air entrained and have a minimum compressive strength of 4,000 psi at 28 days unless higher strength is required by the wall engineer. All concrete properties shall be as specified by the wall engineer.

2. 6 Geogrid Soil Reinforcement: shall be high density polymer grid or fabric specifically designed for soil reinforcement and manufactured by Mirafi, Tensar or Fortrac. Geogrid soil reinforcement shall be in accordance with the following standards:

A. ASTM D4595 - Tensile Properties of Geotextiles by the Wide-Width Strip Method
B. ASTM D5262 - Test Method for Evaluating the Unconfined Creep Behavior of

Geogrids

C. ASTM D6638 Grid Connection Strength (SRW-U1)
D. ASTM D6916 Grid Shear Strength (SRW-U2)
E. GRI-664 - Grid Long Term Allowable Design Strength (LTDS)
F. GRI-665 - Grid Pullout

2.7 Modular Concrete Block Retaining Wall Units: shall be in accordance with the following standards:

A. ASTM C1372-04 Standard Specification for Segmental Retaining Wall Units.
B. ASTM 1262-98 Evaluating the Freeze thaw Durability of Manufactured CMU's and Related concrete Units
C. ASTM C140 Sample and Testing concrete Masonry Units

2.7.1 Modular concrete wall units shall have minimum 28 day compressive strength of 3000 psi in accordance with ASTM C1372-04 and shall have adequate freeze-thaw protection with an average absorption rate of 7.5 lbs per cubic ft. Individual wall unit dimensions shall be uniform and consistent having maximum dimensional deviations of 0.125 in., not including textured face. The exterior face of wall units shall be permanently colored and textured in owner selected style and color. Concrete wall unit color and texture shall be consistent throughout the project without evidence of color variation to the satisfaction of the engineer and owner.

2.7.2 The retaining wall system shall include an attractive, permanently attached cap block as recommended by the manufacturer.

2.7.3 The retaining wall system shall include a complete, adequately sized, integrated drainage system discharging to locations or structures approved by the engineer. Subsurface drainage piping shall be slotted or perforated HDPE pipe specifically designed for the site specific usage. HDPE drainage piping shall be double walled with exterior corrugations and an integrally formed, smooth interior waterway. HDPE shall be in accordance with AASHTO Type S with annular exterior corrugations and an essentially smooth interior waterway braced circumferentially with circular ribs which are formed simultaneously with an outer wall. Pipe and fittings shall comply with the requirements for test methods for AASHTO Designations M 252 and M294 and shall be made from virgin polyethylene compounds which comform with the applicable latest edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM D3350. The minimum parallel plate stiffness values, when tested in accordance with ASTM D2412 shall be as follows:

6" through 10":	340 kN/m^2
12":	345 kN/m^2
15":	290 kN/m^2
18":	275 kN/m^2

HDPE fittings shall be one piece molded and have equal strength and water tightness characteristics as required for pipe. Unless approved otherwise, all pipe joints shall be the bell and spigot type. All HDPE joints shall be watertight with an elastomeric gasket meeting the requirements of ASTM F477. Handling and installation of HDPE shall be in accordance with AASHTO Section 30, ASTM Recommended Practice D2321 and as recommended by the manufacturer. All drainage system piping shall be properly sized by the wall engineer, but under no circumstances shall be less than 6" diameter.

2.7.3.1 Stone: for use as drainage course shall be clean washed stone as specified by the wall engineer and shall be in accordance with NCDOT standard specifications.

2.7.3.2 Geotextile filter fabric: shall be non-woven, needle punched fabrics specifically designed and manufactured for long term subsurface drainage applications. All drainage course stone shall be completely encapsulated in geotextile filter fabric. The filter fabric shall be as specified by the wall engineer and shall also meet the minimum strength and physical properties listed in the following table. Additionally, filter fabric permittivity and apparent opening size shall be as specified by the wall engineer.

Property	**Test Method**	**Units**	**Elongation ≥ 50%[1]**
Grab Tensile Strength	ASTM D 4632	N (lbs)	500 (112)
Sewn Seam Strength[2]	ASTM D 4632	N (lbs)	450 (101)
Tear Strength	ASTM D 4533	N (lbs)	180 (40)
Puncture Strength	ASTM D 4833	N (lbs)	180 (40)
Burst Strength	ASTM D 3786	kPa (psi)	950 (138)
Ultraviolet Stability[3]	ASTM D 4355	%	50

[1] A measured in accordance with ASTM D 4632
[2] When sewn seams are required.
[3] After 500 hrs

3.0 EXECUTION

3.1 The Contractor shall construct modular retaining wall systems at the required locations at the elevations and dimensions indicated on the plans to the satisfaction of the engineer and owner. Improper wall construction will be removed, properly disposed of off-site and replaced, at the contractor's expense, until satisfactory results are obtained. Any temporary security and safety measures necessary will be provided, installed and maintained by the contractor and removed by the contractor when no longer needed.

3.2 The subsurface drainage system, subgrade and foundation shall be prepared in strict accordance with the manufacturer's and wall engineer's specifications and requirements. The wall system shall include permanent toe and heel drainage systems designed by the wall engineer and approved by the manufacturer.

3.3 The geogrid reinforcement, backfill and concrete masonry facing shall be prepared in strict accordance with the manufacturer's and wall engineer's specifications and requirements.

3.4 The installed vertical face of the concrete masonry wall units shall be cambered towards the filled side of the wall at approximately 5/8" per vertical foot or the manufacturer's standard camber.

3.5 The installed wall shall be true and straight in alignment and position. All exposed surfaces of the concrete masonry wall facing shall be shall not exceed the required dimensions and straightness by more than 1/2 inch in 40 feet with the entire wall not exceeding the required dimensions and straightness by more than a total of 1 inch. Retaining walls shall be straight or of uniform curvature and shall conform to the lines, tangents, curves, and transitions as indicated on the plans and required for site specific requirements. The finished lines shall have well defined edges and be free of fluctuations. Any greater deviations from required dimensions and straightness shall be sufficient cause for requiring the materials to be removed and replaced at no additional cost to the owner.

3.6 The contractor shall protect the retaining wall construction as required to prevent damage by rain, run-off or other means throughout construction.

3.7 Following completion of all grading and construction, the contractor shall thoroughly clean the completed wall face to the satisfaction of the engineer and owner.

4.0 METHOD OF MEASUREMENT & BASIS OF PAYMENT

4.1 All work, materials, equipment, labor, testing, incidentals and appurtenances described in this section shall not be measured and paid for as such but shall all be treated as incidental work. The contractor is responsible for including the price of all work covered herein in the lump prices stipulated for related work in the bid form.

END OF SECTION

SECTION 02840
SOIL NAIL RETAINING WALL SYSTEMS

1.0 GENERAL

1.1 Description: The Contractor shall furnish all materials, labor, equipment, supplies, design, testing, maintenance and incidentals necessary to construct soil nail retaining wall systems at the locations, elevations, dimensions as indicated on the plans and as required to accommodate the successful completion of all work. A soil nail is defined as a high strength steel bar installed in bored hole inclined below horizontal and fixed in place with a specialized grouting system. The soil nail retaining wall system shall consist of soil nails installed in a site specific pattern, with nail heads embedded and connected to a reinforced shotcrete face, a permanent reinforced concrete architectural facing, properly functioning surface and subsurface drainage systems, all earthwork and associated work, material, labor and appurtenances necessary for a complete, properly installed, long-term retaining wall system. The contractor shall provide the soil nail portion of the project as a design/build installation as described herein. The appearance of the completed soil nail retaining wall shall be to the satisfaction of the engineer and owner.

1.1.1 Soil nail retaining walls and associated work shall be in strict compliance with the NC Department of Transportation (NCDOT) Geotechnical Engineering Unit, Soil Nail Retaining Walls Provision, dated December 16, 2008 except as modified herein and elsewhere in the bid documents. NCDOT measurement and payment terms described in the Soil Nail Retaining Walls Provision and payment terms in any other NCDOT publications will not apply to this project. There shall be no separate payment for soil nail retaining walls and related work. All payment for soil nail retaining walls and related work shall be included in the lump sum base bid price for all work. The soil nail retaining wall system shall be in accordance with applicable portions of the NC Building Code and any additional applicable local, state, national and international codes and regulations, whichever, in the opinion of the engineer, has the most stringent requirements.

1.2 The contractor shall employ, at the contractor's sole expense, a soil nail wall specialty contractor and a wall engineer fully responsible for the successful design and installation of the entire soil nail retaining wall system. The soil nail contractor shall have successfully completed at least five (5) soil nail wall installations within the last four (4) years with wall heights and exposed face areas equaling or exceeding the requirements for this project. The soil nail contractor shall have an experienced project manager and an experienced field superintendent, (each having a minimum of 5 years experience in soil nail wall construction) capable of installing the soil nail wall in strict accordance with the wall engineer's design and site specific recommendations during construction. The soil nail contractor shall also have in their employ, experienced shotcrete nozzlemen certified, in the particular types of work employed on this project, as American Concrete Institute (ACI) Shotcrete Nozzlemen. The contractor shall review and approve the soil nail contractor experience and qualifications and shall submit four approved hardcopies of the soil nail contractor's personnel, experience,

qualifications and work references to the engineer for review. References shall include a contact name, title, address and telephone number for a minimum of three (3) previous soil nail projects.

1.3 At no additional cost to the owner, the soil retaining wall system to be provided by the contractor shall include a complete, integrated, site specific soil nail retaining wall system design by a qualified, licensed NC Professional Engineer, ("wall engineer") having a minimum of 5 years experience in soil nail retaining wall design and construction. The design provided by the wall engineer shall include, but shall not be limited to, soil nails, soil nail connections and embedment, reinforced shotcrete, reinforced concrete (poured in place or shotcrete) architectural facing, foundation system, wall surface and subsurface drainage systems, soil nail verification testing, concrete testing, any and all soils testing and evaluations as may be necessary by a qualified geotechnical laboratory (laboratory to be under the supervision of an experienced NC Professional Geotechnical Engineer), to properly design and construct the soil nail retaining wall system. Further, at no additional cost to the owner, the wall engineer shall be responsible for engaging the services of a qualified NC Professional Geotechnical Engineer (wall geotechnical engineer) and associated qualified geotechnical laboratory to provide all necessary geotechnical testing, evaluations, analyses, materials testing and quality control as needed to insure the proper design, construction and completion of the wall system and associated work, to the satisfaction of the wall engineer, as evidenced by the wall engineer's certification of satisfactory completion the installed wall system.

1.3.1 A minimum factor of safety of 1.5 shall be used as a basis of design by the wall engineer for soil nail retaining walls and all associated appurtenances. Additionally, the wall engineer shall incorporate an analysis of global stability in the wall design and shall base the design on a minimum factor of safety of 1.5 for long term global or mass stability.

1.3.2 Shop submittals, including all design calculations, signed and sealed by the wall engineer, shall list all factors of safety, soil parameters and design parameters employed by the wall engineer in preparing each wall design. All soil nail shop submittals shall be reviewed and signed and sealed by the wall engineer and shall include, but not limited to, wall elevations with soil nail locations, typical sections, soil nail details, surface and subsurface drainage devices, shotcrete, leveling pads, reinforced concrete facing, architectural finishes and all necessary appurtenances. At the time of shop drawing and design submission to the engineer, the wall engineer shall submit a letter, bearing the wall engineer's NC seal and signature, certifying that the soil nail retaining wall design meets all requirements of the contract documents and other codes and standards applicable to the site specific location of installation. See paragraph 1.3.7 for additional requirements.

1.3.3 Soil design parameters, including but not limited to, shear strength parameters and all other recommendations, when provided by the owner's geotechnical engineer as a part of the bid documents, will be considered minimum design criteria, but shall not be relied upon by the wall engineer or the wall geotechnical engineer without verification through further site specific soil testing and analyses to be performed by the wall engineer and wall geotechnical

engineer. All site specific testing and analyses, necessary for the proper design and successful construction of soil nail retaining wall systems, shall be performed and provided at no additional cost to the owner.

1.3.4 The wall engineer shall be responsible for designing the soil nail retaining wall system to adequately resist seismic loading, as described by the NC Building Code and other applicable codes for the particular location of installation, while maintaining a minimum 1.2 factor of safety for earthquake loading as recommended by the owner's geotechnical engineer.

1.3.5 The wall engineer shall incorporate into the soil nail wall system design, adequate provisions for expansion and contraction as required to limit and control cracking and provide a finished wall appearance acceptable to the engineer.

1.3.6 The wall engineer shall be responsible for designing the soil nail retaining wall system and all associated appurtenances for a minimum service life of 100 years.

1.3.7 The contractor shall submit shop submittals for all materials and methods of installation signed and sealed by the wall engineer. Shop drawings submittals shall also include the architectural style and color pigment samples for the reinforced concrete wall facing for the owner to review and select the style(s) and color(s) of wall facing. Six (6) copies of all shop submittals and design calculations shall be submitted to the engineer for review. Materials which have not been approved shall not be delivered for use on the project. The engineer's review of shop drawings in no way relieves the contractor of his sole responsibility to insure the suitability of all materials used on the project, including but not limited to dimensions, size, capacity, brand, compatibility and any other product or material properties. Any unacceptable or unsuitable materials or products incorporated into the project shall be removed and replaced to the satisfaction of the engineer.

1.3.8 The wall engineer and wall geotechnical engineer shall conduct periodic site visits as necessary to conduct tests and observe wall construction throughout construction as required for the wall engineer to submit a signed and sealed certification statement to the engineer. The signed and sealed certification statement shall state:

> *I, _____ (wall engineer's full name and NC Professional Engineer License Number), having been authorized to periodically observe the construction of Soil Nail Wall (insert wall number or name) for the Proposed Site Improvements for ELEVATE in Jackson County, NC, do hereby state, that to the best of my knowledge and abilities, Soil Nail Wall (insert wall number or name), including associated appurtenances, was constructed within significant intent and compliance of the design as submitted, the contract documents for the project, other applicable codes.*

An original copy of the wall engineer's certification of construction shall be submitted to the engineer prior to release of final payment to the contractor.

1.4 All materials, methods and workmanship shall be in accordance with other applicable sections of these specifications and the latest editions of the NC Department of

Transportation (NCDOT), "Standard Specifications for Roads and Structures," latest edition and soil nail retaining wall related documents by the NCDOT Geotechnical Engineering Unit whichever is, in the opinion of the engineer, the most stringent.

1.5 Contractor shall take all the necessary measures to prevent any damage to any public or private properties, structures, utilities, facilities, etc. Should any damage occur, the contractor shall be fully responsible for making the necessary repairs or replacements, at the contractor's expense, to the satisfaction of the engineer and owner.

1.6 The contractor shall be responsible for obtaining all building permits associated with wall construction at the contractor's expense.

2.0 MATERIALS

2.1 The contractor shall furnish all materials, equipment, labor and incidentals required to successfully accomplish all work to the satisfaction of the engineer and owner. All materials shall be new and in accordance with the wall engineer's and manufacturer's requirements and in accordance with the following.

2.2 All materials shall be delivered on pallets and stored on elevated platforms, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and or other causes.

2.3 Aggregates: shall be clean, well-graded, compactable aggregate in accordance with the wall engineer's specifications and the NCDOT Standard Specifications, latest edition.

2.4 Shotcrete: shall be in accordance with NC Department of Transportation (NCDOT) Geotechnical Engineering Unit, Provisions and Notes and, in particular, the Shotcrete provision, dated April 15, 2008. Shotcrete shall be in accordance with ACI standards and recommendations and shall have a minimum compressive strength 2,000 psi at 3 days and a minimum compressive strength of 4,000 psi at 28 days. Additionally, all shotcrete properties shall be as specified by the wall engineer.

2.5 Concrete: shall be air entrained and have a minimum compressive strength of 4,000 psi at 28 days unless higher strength is required by the wall engineer. Additionally, all concrete properties shall be as specified by the wall engineer.

2.6 Concrete Color and Sealer: Regardless of the type of permanent wall facing selected by the owner, the exposed, finished concrete face of the soil nail wall shall be tinted or stained in an manner, style and color approved by the owner. The concrete color may be achieved through the use of a pigment admixture and/or a permanent chemical stain(s). Pigment admixtures shall be in the form of a powder specifically designed for uniformly coloring throughout concrete during the batch mixing stage. When used, concrete pigment shall be in accordance with ASTM C979 "Standard Specification for Pigments for Integrally

Colored Concrete." Stains shall be the types which are specifically designed for long term outdoor concrete application and which chemically react with the concrete to permeate and infuse a permanent color that will not flake off or peel away. Regardless of the type of coloring methods employed, the finished concrete surface shall be completely covered with a sealer specifically designed for outdoor use to provide long term resistance to weathering and discourage graffiti adherence as described by ASTM D7089. As an integral part of shop drawing submittals, the wall designer shall provide a sufficient number photographs and color charts, which are representative of actual finished surfaces and are sufficient to provide the owner with a wide range of color options and color effects. The final color selection will be made by the owner.

2.7 Wall Drainage: The soil nail retaining wall system shall include a complete, adequately sized, integrated drainage system discharging to locations or structures approved by the engineer. Subsurface drainage piping shall include geocomposite drain strips installed between the excavation face and the shotcrete, properly interconnected to a central drainage system and properly connected to drainage structure(s). Geocomposite drain strips shall be a minimum of 12" wide and consist of a polystyrene or HDPE drainage core and a non-woven polypropylene filter fabric bonded to one side of the core. The minimum average role values for geocomposite drain strips shall be 1/4" to 1/2" thick in accordance with ASTM D5199, 40 psi compressive strength in accordance with ASTM D1621 and a minimum flow capacity of 5 gpm per ft of width tested (with a gradient of 1.0) in accordance with ASTM D4716. All other subsurface and surface drainage collection systems components shall be watertight using HDPE pipe, fittings and appurtenances specifically designed for the site specific usage. All HDPE drainage piping shall be double walled with exterior corrugations and an integrally formed, smooth interior waterway. HDPE shall be in accordance with AASHTO Type S with annular exterior corrugations and an essentially smooth interior waterway braced circumferentially with circular ribs which are formed simultaneously with an outer wall. Pipe and fittings shall comply with the requirements for test methods for AASHTO Designations M 252 and M294 and shall be made from virgin polyethylene compounds which comform with the applicable latest edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM D3350. The minimum parallel plate stiffness values, when tested in accordance with ASTM D2412 shall be as follows:

6" through 10":	340 kN/m2
12":	345 kN/m2
15":	290 kN/m2
18":	275 kN/m2

HDPE fittings shall be one piece molded and have equal strength and water tightness characteristics as required for pipe. Unless approved otherwise, all pipe joints shall be the bell and spigot type. All HDPE joints shall be watertight with an elastomeric gasket meeting the requirements of ASTM F477. Handling and installation of HDPE shall be in accordance with AASHTO Section 30, ASTM Recommended Practice D2321 and as recommended by the manufacturer. All drainage system piping shall be properly sized by the wall engineer, but

under no circumstances shall be less than 6" diameter except as specifically shown otherwise on the plans.

2.8 Soil Nails: shall be epoxy coated or encapsulated deformed steel bars meeting the requirements of AASHTO M275 or M31, Grade 60 or 7. Bar centralizers shall be PVC, steel or other material not detrimental to the soil nail bars. Centralizers shall maintain the bar position in the center of the drilled hole and shall allow the tremie to be inserted to the bottom of the hole during grouting without interference. For encapsulated bars, centralizers shall be provided inside and outside of the encapsulation.

3.0 EXECUTION

3.1 The Contractor shall construct soil nail wall systems at the required locations at the elevations and dimensions indicated on the plans to the satisfaction of the engineer and owner. Improper wall construction will be removed, properly disposed of off-site and replaced, at the contractor's expense, until satisfactory results are obtained. Any temporary security and safety measures necessary will be provided, installed and maintained by the contractor and removed by the contractor when no longer needed.

3.2 The Contractor shall employ equipment, methods, materials and means capable of successfully installing soil nail retaining wall systems under site conditions specific to the project site, including but not limited to, space and access limitations of the site.

3.3 The subsurface drainage system shall be provided and installed in strict accordance with the manufacturer's and wall engineer's specifications and requirements. The wall system shall include complete, permanent surface and subsurface drainage systems as an integral part of soil nail wall construction. The surface drainage system upslope of the wall shall include properly lined and protected swales or ditchlines as needed to divert surface water into storm drain inlets. Storm drain surface inlets and associated piping shall be as shown on the plans and as specified in related sections of these specifications.

3.4 Should unforeseen conditions be encountered during face excavation, drilling operations, or other aspects of wall construction, the wall engineer and soil nail contractor shall make the appropriate design and construction modifications to successfully complete the construction in accordance with the bid documents at no additional cost to the owner. No additional payment will be made for soil nail walls regardless of conditions or materials encountered.

3.5 The temporary or initial shotcrete wall face shall completely cover and encapsulate all nail heads and other wall components and shall be applied, trimmed, filled and leveled in a manner which will provide a temporary planar surface conforming to the required alignment, both vertically and horizontally, within a tolerance of no more than 2 inches of variation in 10 feet with the entire temporary wall surface not exceeding the required dimensions and straightness by more than a total of 4 inches. The temporary wall surface shall have a

minimum thickness of 6 inches at all locations. The temporary wall surface shall be installed with proper alignment and shall provide sufficient dimension allowances for the subsequent installation of the permanent wall facing to the minimum thickness specified while insuring the finished wall conforms to the lines and grades shown on the plans. The temporary or initial shotcrete wall shall be incorporated into and become a integral part of the permanent wall system.

3.6 Architectural Wall Facing: Soil Nail Wall construction shall include the installation of an architectural textured and patterned, reinforced concrete, permanent wall facing, neatly formed and finished and completely covering and properly secured to the temporary shotcrete wall surface. The permanent wall facing shall provide an attractive, finished appearance acceptable to the owner, architect and engineer. The permanent wall facing shall be designed and certified by the wall engineer as an integral portion of the soil nail wall system.

3.6.1 The permanent wall facing system, shall be a carved and sculpted, reinforced shotcrete wall facing, covering the entire temporary shotcrete surface, which imitates and closely replicates the appearance and color of natural rock forms similar to the geology of the local area. The finishing of the permanent wall facing system shall be performed by a specialty subcontractor, with craftsmen in their employ having a minimum of 6 years experience in sculpting and staining shotcrete retaining wall surfaces into natural geologic forms.

3.6.2 As an integral part of shop drawing submittals, the wall designer shall provide photographs and examples of a minimum of eight (8) previously constructed, sculpted walls and shall provide a minimum of 5 selections of styles for the use in selecting a final rock form and color scheme. As a part of shop drawing submittals, the wall finish specialty subcontractor, shall be required to demonstrate the necessary experience, qualifications, references and examples of prior successful projects to the satisfaction of the owner, architect and engineer.

3.6.3 The permanent wall facing system shall provide a uniform surface, to the extent possible, to the alignment shown on the plans, while allowing the craftsman the freedom to sculpt and imitate a natural rock form. The exposed surface of the sculpted, permanent wall facing shall not extend in the direction of the exposed wall face beyond the alignment and dimensions shown on the plans. The permanent wall facing shall have a minimum thickness of 4 inches at all locations as measured from the face of the temporary shotcrete wall surface to the deepest, carved or sculpted relief on the exposed surface of the permanent wall facing.

3.6.4 The top of the sculpted wall facing shall extend above finished grade by a minimum of 6 inches in all locations as required to prevent drainage from pouring over the wall face and as required to direct surface drainage into the surface drainage system located upslope of the wall system. The wall facing shall have adequate provisions to incorporate the required surface drainage system upslope of the wall

3.7 The contractor shall protect the soil nail retaining wall construction as required to prevent damage by rain, run-off or other means throughout construction.

3.8 Following completion of all grading and construction, the contractor shall thoroughly clean the completed wall face to the satisfaction of the engineer and owner.

3.9 Soil nail walls shall be constructed from the top down, excavating no more than 3 feet below where soil nails are to be installed. Shorter cuts shall be employed when recommended by the wall engineer for site specific recommendations. Shotcrete shall be applied to the excavation face no more than 24 hours after excavating any lift.

3.10 Soil nail verification and proof tests shall be performed by installing sacrificial, verification test nails which shall be utilized as proof test nails. Soil nail verification and proof testing shall be performed at the contractor's expense and in the minimum number and in accordance with the testing guidelines and outlined in the NCDOT Geotechnical Engineering Unit, Soil Nail Retaining Walls Provision, dated December 16, 2008. All soil nail verification and proof tests shall meet the minimum acceptance criteria of this NCDOT document and shall be in accordance with the requirements of the wall engineer. All test nails shall be sacrificial and shall not be incorporated into the wall.

END OF SECTION 02840