GEOTECHNICAL EXPLORATION AND SUBGRADE RECOMMENDATIONS

SUMMIT POINT PHASE II APARTMENTS
Lee's Summit, Missouri
CFS Project No. 21-5065

Prepared For
Canyon View Properties
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February 23, 2021

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SYNOPSIS

A subsurface exploration and an evaluation were performed at the planned Summit Point Phase II Apartments project site to provide geotechnical engineering related recommendations for design and construction of the proposed project.

Exploratory soil borings have been drilled and a laboratory testing program was conducted on selected soil samples. The data has been analyzed based upon the project information provided the project team.

The results of the exploration and analysis indicate that conventional spread and continuous wall footings appear to be a suitable foundation system for support of the proposed structure. Detailed analysis of subsurface conditions, any alternate foundation types, and pertinent design recommendations are included, herein.

Groundwater conditions are not expected to cause any major difficulties. These conditions will be further discussed in the report. Please note, groundwater levels should be expected to fluctuate based on seasonal changes and precipitation events.

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1 INTRODUCTION

1.1 PURPOSE

The purpose of this geotechnical exploration was to evaluate the underlying materials at the proposed Summit Point Phase II Apartments project site, and based upon this information, provide geotechnical engineering related recommendations for design and construction of the planned project. This exploration was performed in accordance with Cook Flatt & Strobel Engineers', P.A. (CFS) proposal dated January 13, 2021 and authorized by Canyon View Properties.

This report includes geotechnical recommendations and considerations pertaining to site development, foundation support, concrete slab on grade and pavement construction. Also, included in this report are earthwork, construction and drainage considerations associated with the proposed project.

1.2 SCOPE OF SERVICES

This exploration and this analysis include an engineering reconnaissance of the planned site, a subsurface exploration as outlined below, a field and laboratory testing program, and an engineering analysis and evaluation of the subsurface materials.

The scope of services did not include any environmental assessment for wetlands or hazardous materials in the soil, surface water, groundwater, air or surrounding area. Any statement in this report or on the boring logs regarding odors, colors or unusual or suspicious items is strictly for the information of the client.

1.3 GENERAL

The general subsurface conditions used in this analysis are based upon an interpolation of the subsurface data between the borings; varying conditions may be encountered between boring locations. If deviations from the noted subsurface conditions are encountered during construction, they should be brought to the attention of the Geotechnical Engineer.

The recommendations submitted for the proposed structure are based on the available soil information and the preliminary design details. Any revision in the plans for the proposed structure from those described in this report should be brought to the attention of the Geotechnical Engineer to determine if changes in the foundation recommendations are required.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, and professional advice contained, herein, have been presented after being prepared in accordance with generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics and engineering geology. No other warranties are implied or expressed.

After the plans and specifications are complete, it is recommended that the Geotechnical Engineer be provided the opportunity to review the final design and specifications, in order to verify that the earthwork and foundation recommendations are properly interpreted and implemented.

2 PROJECT DESCRIPTION

It is understood that the planned project comprises the new construction of seven (7), three-story apartment buildings in Lee's Summit, Missouri with associated parking and drive lanes. The apartments will be wood-framed, concrete slab on grade structures with stepped finish floor elevations. CFS anticipates the associated foundations will step with the finish floor elevations. The proposed finish floor elevations vary at each building and range from 1004.5 to 1012.0. Foundation loads are expected to be on the order of 50 kips for column footings and two (2) to three (3) kips per linear foot for continuous wall footings.

The apartments are planned to be similar in elevation to the existing grade, with the stepped finish floor elevations mirroring the existing grades. However, CFS does anticipate cut and fill amounts on the order of three (3) feet, plus or minus, will be necessary to achieve the desired construction grades.

If any changes to the project occur, please notify CFS to allow for review of these changes and, if necessary, amend this report.

2.1 SITE LOCATION & SURFACE CONDITIONS

The project site is located at 504 NE Chipman Road in Lee's Summit, Missouri. The project site is bounded by the existing Summit Point apartments to the south and the English Manor Drive cul-de-sac to the east. A creek traversing east-west comprises the northern border and the athletic fields of Lee's Summit North High School are located on the western side of the planned project site.

Currently, the project site is primarily grass covered with some trees throughout. The site slopes downward from the south to the north as it approaches the existing creek. The creek is lined with trees on both sides.

2.2 SITE GEOLOGY

Soils in the greater Kansas City area are generally residual soils, alluvial deposits, or till. Residual soils formed as a result of weathering of bedrock, or by weathering of sediments that were transported by water, ice, wind, or a combination of these. Regional soils derived from shale, limestone, and loess have high shrink-swell potentials. Major alluvial deposits occur along the Missouri and Kansas rivers and their tributaries. These consist of clay, sand, and gravel sized sediments. Northern parts of the city were glaciated during the early Pleistocene time resulting in till deposits. Surface bedrock in northeastern Kansas and northwestern Missouri generally consist of limestone and shale (with sandstone found in prehistoric channels) arranged in nearly horizontal beds or layers that can be followed continuously over long distances. These bedrocks are part of the Pennsylvanian bedrock system.

3 SUBSURFACE EXPLORATION

Based on the project information as outlined above, CFS Engineers conducted a field exploration to determine the underlying materials at the proposed project site and to establish their engineering characteristics.

3.1 SCOPE OF WORK

This geotechnical exploration consisted of drilling 18 borings at the planned project site. 14 structural borings with planned depths of 15 feet beneath existing site grade were drilled in the footprints of the planned apartment buildings, and four (4) pavement borings with planned depths of five (5) feet beneath existing site grade were drilled in the pavement areas. The borings were drilled to their planned depths or auger refusal, whichever occurred first. The boring locations can be seen on the Boring Location Plan included in Appendix A.

The boring locations were determined in the field using measurements from existing landmarks and should be considered accurate only to the degree implied. The locations were established by Cook, Flatt & Strobel Engineers.

The elevation of the ground surface shown on each test boring log was obtained from Google Earth and should be considered accurate only to the extent implied.

Boring logs representing the materials encountered in the borings are included in Appendix B. The boring logs represent CFS Engineers' interpretation of the field logs combined with laboratory observations and testing of the samples. The stratification boundaries indicated on the boring logs were based on field observations, an extrapolation of information obtained by examining samples from the borings, and comparisons of soils and/or bedrock types with similar engineering characteristic. As such, the boundaries between subsurface strata should be expected to vary from the logs to some extent.

The depth to groundwater, if encountered, was recorded in each test boring during drilling and can be seen in Section 3.5, Groundwater Conditions. After completion of drilling, sampling, and field testing, the excavations were backfilled with auger cuttings.

3.2 DRILLING AND SAMPLING PROCEDURES

The auger borings were drilled using a truck mounted SIMCO 2400 drill rig equipped with a rotary head. 3.25-inch solid-stem augers were used to drill the holes. During drilling, field logs were created and maintained by CFS personnel to catalog the materials encountered.

Representative samples were obtained during drilling using split-barrel sampling procedures in general accordance with the procedures for "Standard Test Methods for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils" (ASTM D 1586).

Upon completion of drilling, the samples were then sealed and returned to CFS's laboratory for further examination, classification, and testing. The samples recovered were identified, classified, and evaluated by a Geotechnical Engineer.

3.3 FIELD TESTS AND MEASUREMENTS

During the soil boring procedure, Standard Penetration Tests (SPT) were performed at pre-determined intervals to obtain the standard penetration value of the soil as outlined in the ASTM D1586 test method. The standard penetration value (N) is defined as the number of blows of a 140-pound hammer falling 30 inches, required to advance the split-barrel sampler one foot into the soil. The sampler is lowered to the bottom of the previously cleaned drill hole and advanced by blows from the hammer.

The number of blows is recorded for each of three successive increments of six inches penetration. The "N" value is then obtained by adding the second and third incremental numbers. The results of the standard penetration test are shown on the Boring Logs and indicate the relative density of cohesionless soils and comparative consistency of cohesive soils, and thereby provide a basis for estimating the relative strength and compressibility of the soil profile components.

The Standard Penetration Test (SPT) was also used to evaluate the consistency of the in-situ materials. The N-values for the site's materials were found to range from 3 to 50+ blows/foot.

3.4 SUBSURFACE CONDITIONS

The materials encountered in the test borings have been visually classified according to the Unified Soil Classification System (USCS). Specific subsurface conditions encountered—including field tests, lab tests, and water level observations—at the boring locations are also presented on the individual boring logs found in Appendix B of this report. The following table presents a general summary of the major strata encountered during this subsurface exploration.

Table 1: General Subsurface Conditions

STRATUM	MATERIAL	DEPTH TO BOTTOM OF STRATUM (FT)	MEASURED N-VALUES	COMMENTS
1	TOPSOIL	0.5 to 1.0	NA	Dark Brown LEAN CLAY with roots and organics
2	LEAN CLAY (CL)	3.0	3 to 7	Dark brown and grayish brown, soft to medium stiff with roots. Only encountered in borings B3, B9, and B13.
3	FAT CLAY (CH)	7.0 to 13.0	5 to 26	Grayish brown, gray, and brown with iron nodules. Some fine sand encountered near shale layer.
4	SANDSTONE	8.0 to 13.6	43 to 50+	Tan, moderately weathered to slightly weathered. Encountered in borings B1 and B9. Auger refusal on Sandstone in Boring B9.
5	SHALE	9.5 to 15.0	10 to 50+	Tan and gray, highly weathered to slightly weathered. Typically encountered above limestone bedrock. Split spoon refusal in borings B2, B3, B5, B6, B13, and B14.
6	LIMESTONE	7.8 to 13.5	NA	Auger refusal on Limestone bedrock in Borings B1, B4, B7, B8, B10 through B12.

Note: the boundaries between subsurface strata should be expected to vary from this table and the logs to some extent.

3.5 GROUNDWATER CONDITIONS

Free water was encountered during drilling in Borings B5, B9, and B13 at depths ranging from 12 to 14 feet beneath existing site grade. The remaining borings stayed dry and no free water was measured. The depth of groundwater is included in the boring logs in Appendix B.

Please note, the reported groundwater levels reflect the conditions observed at the time the borings were drilled. Groundwater levels should be expected to fluctuate with changes in grading, precipitation changes and seasonal changes. The water levels included in this report do not indicate a permanent groundwater condition. Additionally, the materials encountered during this exploration are, generally, low permeable soils.

4 LABORATORY TESTING

Upon completion of drilling, the samples were returned to CFS's laboratory located in Kansas City, Kansas for laboratory testing. A supplemental laboratory testing program was conducted to evaluate additional engineering characteristics of the in-situ soils necessary in analyzing the behavior of the support systems for the proposed building.

The laboratory testing program included the following tests:

- Supplementary visual classification (ASTM D2488) of all samples,
- Water content (ASTM D2216) of all samples, and
- Atterberg limit tests (ASTM D4318) on a selected sample.

The results of the laboratory testing program can be seen in on the boring logs in Appendix B. The Atterberg limits can be seen in the following table.

Table 2: Atterberg Limits Results

Boring ID	Sample #	Moisture Content (%)	Atterberg Limits			USCS Classification
			Liquid Limit	Plastic limit	Plasticity Index	
B3	SS1	30.0	46	25	21	LEAN CLAY (CL)
B6	SS1	23.0	60	26	34	FAT CLAY (CH)
B9	SS1	22.0	36	22	14	LEAN CLAY (CL)
B11	SS1	30.0	51	27	24	FAT CLAY (CH)
B13	SS1	32.0	41	23	18	LEAN CLAY (CL)

Based on the Atterberg limits, the overburden material classifies as both Lean Clay (CL) and Fat Clay (CH) and is considered moderately to highly expansive. To limit the risk of differential slab movements, all concrete slabs on grade should be constructed in accordance with Section 7.2, "Slab On Grade" of this report.

5 GEOTECHNICAL CONCERNS

The following geotechnical concerns are based upon the subsurface materials encountered during this exploration and CFS's understanding of the project as described in Section 2, Project Description of this report. If any changes to the planned structure's location, loading or elevations occur, CFS must be allowed to review these changes, and if necessary, issue amendments to this report and its recommendations.

- *Expansive Clay Soils*: Expansive clay soils were encountered during this exploration. The on-site materials are NOT suitable for direct support of concrete slabs and foundation wall backfill. It is recommended that all foundation walls be backfilled with open graded stone (such as No. 57 as referenced in ASTM C33) from two feet behind the wall rising at a 45-degree angle to within two (2) feet of the ground surface to allow for proper drainage and relief of any hydrostatic pressure build-ups that may occur in the native fat clay. All slabs on grade should be supported by a minimum 24-in-thick mat of low volume change material (LVC) constructed in accordance with Section 7.2, Slab on Grade Recommendations of this report.

6 EARTHWORK & SITE DEVELOPMENT

6.1 SITE PREPARATION

Prior to filling, the grass and topsoil should be stripped from all structural areas and be stockpiled for later use in landscape areas or it should be wasted. Any trees and shrubs should be properly removed including the entirety of the root ball and root systems. The upper 12-inches of the subgrade should be moisture conditioned and recompacted, as necessary, to provide a stable subgrade upon which to begin placement of engineered fill.

Upon completion of stripping and prior to filling, the newly exposed subgrade should be evaluated by a qualified professional for stability by means of proofrolling. The proofroll should be conducted using a fully loaded, tandem axle dump truck weighing in excess of 25 tons. Any soft or unsuitable areas identified during the proofroll should be corrected by means of additional moisture conditioning and recompacting, or removal and replacement with an acceptable material.

Additionally, although not encountered during this exploration, any undocumented fill encountered during construction should be completely removed from beneath the planned foundations. Undocumented fill is any foreign material that was placed or dumped in an uncontrolled manner (i.e. no records of testing exist from the time of placement). Undocumented fill is inconsistent and unpredictable in nature, and it should not be used in support of any foundation systems. Undocumented fill is permitted beneath non load bearing floor slabs given it is thoroughly evaluated by CFS during construction by means of a proofroll outlined above.

6.2 FILL MATERIALS

All general and structural fill should be free of debris and defined by ASTM 2487 as CH, CL, ML, GW, GP, SM, SW, SC, and SP. The onsite soils tend to meet this requirement; however, please note that CH (fat clay) classification materials should NOT be used as structural fill within two (2) feet of the finished grade supporting the building slab and within ten (10) feet laterally outside of the building footprint. Fat clays (CH) with Liquid Limits of greater than 55 should not be used in the upper one (1) foot beneath the pavement without being treated with cement as outlined later in this report.

The on-site topsoil contains organic material and is unsuitable for use as structural fill. Unsuitable materials are those defined by ASTM 2487 as MH, OL, OH, and PT.

6.3 ENGINEERED FILL PLACEMENT

For the purpose of this report, engineered fill means fill placed in controlled layers and compacted and tested according to accepted geotechnical engineering practices to ensure that it meets the required specifications. While structural fill refers to any engineered fill placed within the footprint of the planned structures. Engineered fill materials should be free of organic matter. During placement, engineered fill materials should be within the specified moisture contents and compacted to the specified densities given below in Tables 2 and 3. Maximum dry density and optimum moisture content should be determined by the Standard Proctor test (ASTM D 698).

Fill should be placed in six (6) inch lifts (compacted thickness) in mass fill areas, and as needed to obtain the proper compaction in utility trenches and behind walls. Structural fill should extend a minimum of two (2) feet beyond any structure lines.

Table 3: Recommended Moisture Ranges

ENGINEERED FILL MATERIAL	MAXIMUM BELOW OPTIMUM	MAXIMUM ABOVE OPTIMUM
Lean Clay (CL)	-2%	+3%
Fat Clay (CH)	0%	+4%
Compacted Base Rock (i.e. MODOT Type 5, AB3 or equivalent)	NA	NA

Table 4: Compaction Requirements & Testing Frequency

LOCATION OR AREA	REQUIED COMPACTION (%) (ASTM D 698, DRY DENSITY)	TESTING FREQUENCY 3 PER LIFT PER …
Building Walkways	95%	20,000 sf
Retaining Walls	95%	1,000 sf
Trenches	95%	150 lf
Lawn or Unimproved Areas	92%	20,000 sf
Building and Pavement Subgrades	95%	10,000 sf
Out-Parcels	95%	20,000 sf

A representative of the Geotechnical Engineer should monitor filling operations on a full-time basis. A sufficient number of density tests should be taken to verify that the specified compaction is obtained. See Table 3 above for required testing frequency.

6.4 EXCAVATIONS & TRENCHES

All temporary slopes and excavations should conform to Occupational Safety and Health Administration (OSHA) Standards for the Construction Industry (29 CFR Part 1926, Subpart P). Excavations at this site are *expected* to be made in "Type B" clayey soil. Soil types should be verified in the field by a competent individual.

All excavations should be kept dry during subgrade preparation. Storm water runoff should be controlled and removed to prevent severe erosion of the subgrade and eliminate free standing water. Subgrade that has been rendered unsuitable from erosion or excessive wetting should be removed and replaced with controlled fill.

Trenches should be excavated so that pipes and culverts can be laid straight at uniform grade between the terminal elevations. Trench width should provide adequate working space and sidewall clearances. Trench subgrade should be removed and replaced with controlled fill if found to be wet, soft, loose, or frozen. Trench sub-grades should be compacted above 95% of the maximum dry density in accordance with ASTM D 698 at moisture contents between -3% to +3% of the optimum moisture content.

Granular bedding materials for pipes, such as well-graded sand or gravel, may be used provided that the bottom of the trench is graded so that water flows away from building

Bedding material should be graded to provide a continuous support beneath all points of the pipe and joints. Embedment material should be deposited and compacted uniformly and simultaneous on each side of the pipe to prevent lateral displacement. Compacted control fill material will be required for the full depth of the trench above the embedment material except in area landscape area with the compaction may be reduced to 90% Standard Proctor ASTM D 698. No backfill should be deposited or compacted in standing water.

Permanent slopes greater than 3 horizontals to 1 vertical should not be used unless additional testing and slope analysis is performed.

6.5 DRAINAGE AND DEWATERING

Normal seasonal weather conditions should be anticipated and planned for during earthwork. It is recommended that the Contractor determine the actual groundwater levels at the site at the time of the construction activities to assess the impact groundwater may have on construction. Water should not be allowed to collect in the foundation excavation, on floor slab areas, or on prepared subgrades of the construction area either during or after construction. Undercut or excavated areas should be sloped toward one corner to facilitate removal of collected rainwater, groundwater, or surface runoff. Positive site drainage should be provided to reduce infiltration of surface water around the perimeter of the building and beneath the floor slabs. The grades should be sloped away from the building and surface drainage should be collected and discharged such that water is not permitted to infiltrate the backfill and floor slab areas of the building.

The site should be graded such that positive drainage (normally 2% minimum) is provided away from any structures. Where sidewalks or paving do not immediately adjoin the building, protective slopes of at least 5% for a minimum of 10 feet from the perimeter walls are recommended. Roof drains and downpours should also be directed away from the building. Open-graded stone is not recommended for use under sidewalks unless the stone is adequately drained to prevent collection of water under the walks.

The site should also be graded to avoid water flows, concentrations, or pools behind retaining walls, curbs or similar structures. When swales are designed at the top of the walls, proper line and slope should be considered to avoid any flow down behind walls. Special attention is needed for sources of storm water from slopes, building roofs, gutter downspouts and paved areas draining to one point.

In paved areas where seasonal water potentially accumulates behind curbs, gutters and planters ensure concrete extends 6-inches into impervious material to reduce seepage under the curbs, saturating and weakening the pavement subgrade.

Perforated plastic pipes should be placed on the backfilled side of the walls near the bottom and day-lighted. Six inches of open graded crushed rock wrapped with geo-textile fabric should be placed behind the walls up to a depth of two feet below the finished grade. As an alternative to the open graded crushed rock, a manufactured geo-composite sheet drain, such as Mirafi G100N, Contech C-Drain, or equivalent, may be used in conjunction with the perforated pipe.

6.6 LANDSCAPING

Landscaping and irrigation should be limited adjacent to buildings and pavements to reduce the potential for large moisture changes. Trees and large bushes can develop intricate root systems that can draw moisture from the subgrade, resulting in shrinkage of the bearing material during dry periods of the year. Desiccation of bearing material below foundations may result in foundation settlement.

Landscaped areas near pavements and sidewalks should include a drainage system that prevents over saturation of the subgrade beneath asphalt and concrete surfaces. Drainage systems in irrigation areas should be incorporated into the storm drain system.

7 GEOTECHNICAL ENGINEERING RECOMMENDATIONS

7.1 FOUNDATIONS RECOMMENDATIONS

Conventional spread and continuous wall footings are, generally, most economical when the existing soil conditions allow them to be founded at shallow depths on existing materials. Based on the materials encountered during this exploration, it is CFS Engineers' opinion that the planned structure can be supported by a shallow foundation system, such as spread and/or trench footings bearing in native clay soils. Please reference the following table for recommended design parameters.

Table 5: Shallow Foundation Design Parameters

DESIGN PARAMETER	RECOMMENDED VALUE	COMMENTS
Allowable Bearing Capacity (shallow foundations)	2,500 psf	Evaluated based on field and laboratory testing results (1)
Recommended Bearing Material	Native Clay Soils	Uniform bearing material required beneath entirety of foundation system (2)
Anticipated Total Settlement	< 1-inch	Maximum
Anticipated Differential Settlement	< ¾ -inch	Maximum per 100 feet of linear footing
Minimum Recommended width	24 and 16 inches	Spread and trench, respectively
Minimum Recommended Depth	36-inches	Based on seasonal freeze-thaw cycles

(1) If undercutting of any footing is required to reach design bearing capacity, backfill of the undercut footing should be done with lean concrete.
(2) A uniform bearing condition should exist beneath the entirety of the foundation system for a given structure. A representative of the Geotechnical Engineer should test the materials in the footing excavations to verify the material and design bearing pressure. If undercutting of any footing is required to establish a uniform bearing condition, backfill of the undercut footing should be done with lean concrete.

Footings should be suitably reinforced to reduce the effects of differential movement that may occur due to variations in the properties of the supporting soils. Top and bottom reinforcing steel is recommended for continuous wall footings to reduce differential settlement due to possible varying bearing capacities of the existing fill soils.

Every effort should be made to keep the footing excavations dry as the soils will tend to soften when exposed to free water. Footing bottoms should be free of loose soil and concrete should be placed as soon as possible to prevent drying of the foundation soils.

7.2 SEISMIC ANALYSIS

The determination of the seismic class is based on ASCE Standard 7: Minimum Design Loads for Building and Other Structures. Based upon this information, the seismic properties of the soil were interpolated from the standard penetration test values. A Seismic Site Class "D" was determined for this site. In addition, there is no significant risk of liquefaction or mass movement of the on-site soils due to a seismic event.

7.3 SLAB ON GRADE RECOMMENDATIONS

In its current state, the overburden materials (i.e. Fat Clay) encountered during this exploration are unsuitable for direct support of the planned slab on grade. CFS recommends all concrete slabs on grade be supported by a minimum of 24-inches of Low Volume Change (LVC) material. LVC material should consist of lean clay (CL), KDOT AB3, crushed limestone screenings or equivalent. A low volume change material is defined as a material with a liquid limit less than 45 and a plasticity index less than 25. The subgrade can be constructed as outlined below.

1. Cut the subgrade to a minimum depth of 24-inches beneath the planned bottom of slab elevation.
2. Twenty (20) inches of a compacted LCV material should be placed atop the exposed slab subgrade. The LVC should be placed in lifts no greater than 8-inches-thick (compacted thickness) and compacted to 95% of the maximum dry density as determined by ASTM 698. Limestone based LVC material should be compacted at a moisture content sufficient to achieve the desired compaction, and lean clay (CL) material should be compacted at a moisture content between 0 and +4% of optimum.
3. A 4-inch-thick layer of open graded stone (ASTM C33 or equivalent material) should be placed atop the 20-inches of compacted LVC material to return the subgrade to the original bottom of slab elevation. The open-graded stone will ease construction and provide a capillary break between the LVC and concrete slab.

Based on the materials encountered, 100 psi/in can be used as a modulus of subgrade reaction (k_s) for fat or lean clay soils. A subgrade reaction modulus value of 150 psi/in can be used for 20-inches of compacted granular fill such as KDOT AB3, MODOT Type 5 or equivalent.

Every floor slab should be evaluated to determine if a vapor retarder under the concrete floor is required. The slab designer should refer to ACI 302 and/or ACI 360 for procedures regarding the use and placement of a vapor retarder.

To reduce the effects of differential movement, slabs-on-grade should not be rigidly connected to columns, walls, or foundations unless it is designed to withstand the additional resultant forces. Floor slabs should not extend beneath exterior doors or over foundation grade beams, unless saw cut at the beam after construction. Expansion joints may be used to allow unrestrained vertical movement of the slabs. The floor slabs should be designed to have an adequate number of joints to reduce cracking resulting from differential movement and shrinkage. CFS suggests joints be provided on a minimum spacing of twelve (12) feet on center. For additional recommendations refer to the ACI Design Manual. The requirements for the slab reinforcement should be established by the designer based on experience and the intended slab use.

7.4 LATERAL EARTH PRESSURES

Lateral earth pressures are determined by multiplying the vertical applied pressure by the appropriate lateral earth pressure coefficient. If the foundation walls are rigidly attached to the building and not free to rotate or deflect at the top, CFS recommends designing the walls for the *at-rest* earth pressure coefficient. Walls that are permitted to rotate and deflect at the top can be designed for the *active* lateral earth pressure condition. Horizontal loads acting on shallow foundations are resisted by friction along the foundation base and by *passive* pressure against the footing face that is perpendicular to the line of applied force.

It is recommended that all foundation walls be backfilled with open graded stone (such as No. 57) from two feet behind the wall rising at a 45-degree angle to within two feet of the floor slab. The use of stone to backfill behind the walls will expedite construction, reduce potential settlement between the wall and the floor slab and lower the pressure induced on the wall from the backfill thus potentially reducing the thickness of the walls.

Table 6: Earth Pressure and Friction Coefficients

MATERIAL	ACTIVE (K_a)	PASSIVE (K_p)	AT-REST (K_o)	ALLOWABLE BASE FRICTION	UNIT WEIGHT (pcf)
Open-graded crushed limestone	0.27	3.69	0.43	0.47	130-140
In-situ lean clay soils	0.40	2.5	0.68	0.32	120-125
In-situ fat clay and weathered shale soils	0.49	2.04	0.66	0.24	120-125
Lean clay – conditioned and compacted	0.32	3.12	0.48	0.35	120-125
Fat clay/Weathered Shale – conditioned and compacted	0.45	2.2	0.63	0.27	120-130
Limestone Bedrock	-	-	-	0.55	140-150

These earth pressure coefficients do not include the effect of surcharge loads, hydrostatic loading, or a sloping backfill. Nor do they incorporate a factor of safety. Also, these earth pressure coefficients do not account for high lateral pressures that may result from volume changes when expansive clay soils are used as backfill behind walls with unbalanced fill depths. In addition, any disturbed soils that are relied upon to provide some level of passive resistance should be placed in lifts not exceeding six (6) inches in thickness and compacted to a minimum density of 95% of the Standard Proctor (ASTM D698) maximum dry density at a moisture content within +- 3% of the optimum moisture content. It is recommended that a representative of CFS should verify the compaction of any such materials relied upon to provide passive pressure.

The actual earth pressure on the walls will vary according to material types and backfill materials used and how the backfill is compacted. If the backfill conditions are different than the ones used above, CFS should be notified so the recommendations can be modified. The buildup of water behind a wall will increase the lateral pressure imposed on below-grade walls. Adequate drainage should be provided behind any below grade walls as described in this report. The walls should also be designed for appropriate surcharge pressures such as adjacent traffic, interior building floor slab loads, and construction equipment.

7.5 Pavement Recommendations

The pavement sections presented below are considered typical and minimum for the report basis parameters. The client should be aware that thinner pavement sections might result in increased maintenance costs and lower than anticipated pavement life. The pavement area subgrade consists of moisture sensitive soils.

The soils expected beneath the pavement are clay soils. Please note that clays tend to expand and contract with changes in moisture and weather conditions, and they are considered very moisture susceptible, losing strength quickly. If moisture becomes an issue during construction, or stability of the sub-grade soils does not meet the requirements of this report, the on-site soils can be stabilized with 5% by dry unit weight Portland Type 1/2 Cement for a depth of nine (9) inches to extend the life of the pavement. If the client prefers to use Portland cement stabilized soils, the pavement sections below can be re-evaluated and possibly reduced.

Table 7: Recommended Light Duty Pavement Sections (Parking lots)

Recommended Thicknesses (inches) – Light Duty			
Asphalt		**Concrete**	
APWA Type 3-01 AC Surface	2	Concrete	5
APWA Type 1-01 AC Base (2)	3	Aggregate Base Course	4
Aggregate Base Course (1)	6	Moisture Conditioned & Recompacted Subgrade (LL<55, PI<30, See Section 7.5.1)	12
Moisture Conditioned & Recompacted Subgrade (LL<55, PI<30, See Section 7.5.1)	12		

(1) 9-inches of cement stabilization can be used in lieu of the aggregate base course beneath asphalt.
(2) When base is to be placed in the fall and surface in the spring, APWA Type 2-01 is recommended to improve performance of base due to lower permeability.

Table 8: Heavy Duty Pavement Thicknesses (Truck areas and drives)

<table>
<tr><th colspan="4">Recommended Thicknesses (inches) – Heavy Duty</th></tr>
<tr><th colspan="2">Asphalt</th><th colspan="2">Concrete</th></tr>
<tr><td>APWA Type 3-01 AC Surface</td><td>2</td><td>Concrete (3)</td><td>7 (1)</td></tr>
<tr><td>APWA Type 1-01 AC Base (2)</td><td>6</td><td>Aggregate Base Course</td><td>4</td></tr>
<tr><td>Aggregate Base Course (1)</td><td>6</td><td rowspan="2">Moisture Conditioned & Recompacted Subgrade (LL<55, PI<30, See Section 7.5.1)</td><td rowspan="2">12</td></tr>
<tr><td>Moisture Conditioned & Recompacted Subgrade (LL<55, PI<30, See Section 7.5.1)</td><td>12</td></tr>
</table>

(1) 9-inches of cement stabilization can be used in lieu of the aggregate base course beneath asphalt.
(2) When base is to be placed in the fall and surface in the spring, APWA Type 2-01 is recommended to improve performance of base due to lower permeability.
(3) 8 inches of concrete is recommended for trash and/or recycling dumpster areas.

7.5.1 Pavement Subgrade Preparation

The upper 12 inches of exposed subgrade, extended a minimum of two (2) feet laterally beyond all pavement lines, should be moisture conditioned and recompacted, as necessary, to pass a proofroll evaluation as described in Section 5.1, "Site preparation" of this report.

Any localized soft, wet, or loose areas identified during the proof rolling should be repaired prior to paving. Fill material should be placed in loose lifts up to a maximum of eight (8) inches in thickness and compacted to at least 95% of the maximum dry density in accordance with ASTM D698 at moisture contents outlined in the Earthwork section. Construction traffic should be minimized to prevent unnecessary disturbance of the pavement subgrade. Disturbed areas, as verified by CFS's geotechnical engineer, should be removed, and replaced with properly compacted material.

Fat clays (CH) with Liquid Limits of greater than 55 should not be used in the upper one (1) foot beneath the pavement section without being treated with Type 1/2 Portland cement to a minimum depth of 9-inches at a concentration of 5% by dry unit weight as determined by ASTM D698. Consideration should be given to treating all non-LVC clays so as to extend the life of the pavement, improve performance and reduce maintenance costs. Any cement stabilization should be compacted to 95% of the material's dry unit weight at a moisture content between 0 and +4% of the materials optimum moisture content as determined by ASTM D698. The materials should be compacted in loose lifts not exceeding twelve (12) inches in thickness. This treatment is considered in addition to the recommended granular base.

7.5.2 Aggregate Base Course

The aggregate base recommended in the pavement sections above should be placed in loose lifts not exceeding six (6) inches in thickness and should extend a minimum lateral distance of two (2) feet beyond the pavement lines. This extra width is structurally beneficial for wheel loads applied at pavement edge. The granular based should be compacted to at least 95% of the maximum dry density in accordance with ASTM D698.

If open graded stone is used under the pavement, the pavement subgrade should be graded to provide positive drainage of the granular base section. Provision should be made to provide drainage into the storm water system. The use of a granular blanket drain near storm water inlets that provides weep holes from the drain to the inlets is recommended.

7.5.3 Asphalt Pavement Construction

Asphalt cement (bitumen) used in the manufacture of asphalt pavement should conform to the Performance Grading system. In the project area, the provincial grade asphalt binder course is PG 64-22. The asphaltic mix for conventional roadway should be designed for 4% air voids. During production, the voids can be expected to vary ±1% of the design value of 4%. Under these conditions, the minimum allowable VMA for base and surface course shall be 12% and 14%, respectively.

Immediately after spreading, each course of the pavement mixture should be compacted by rolling. The initial or "breakdown" rolling shall be accomplished with a steel-wheeled vibratory roller. The motion of the roller should be slow enough at all times to avoid displacement of the hot mixture. The surface of the mixture after compaction should be smooth and true to established section and grade. The completed asphalt concrete paving should have a density equal to or greater than 95% for the base and 96% for the surface of theoretical density.

All asphaltic concrete mix designs and Marshall Characteristics should be submitted to our office and reviewed in order to determine if they are consistent with the recommendations given in this report. All materials to be employed and field operations required in connection with the pavement reconstruction should follow requirements and procedural details as per APWA 2001. In addition, representative of CFS should observe and monitor the pavement construction to assure satisfactory compliance with our engineering recommendations.

7.5.4 Concrete Pavement Construction

The pavement on this site will be subjected to freeze-thaw cycles. Sufficient air entrainment in the range of 6% to 8% is required to provide freeze-thaw durability in the concrete. Concrete with a 28-day specified compressive strength of 4,000 psi is recommended. The concrete mix should contain at least 564 pounds of concrete per cubic yard. A mixture with a maximum slump of 4 inch +/- 1 inch is acceptable. If a water-reducing admixture is specified, slump can be higher. For better performance and crack control, synthetic fiber reinforcement such as Fibermesh® 300 is recommended for the concrete instead of welded wire mesh. Add synthetic fiber reinforcement to concrete mixture in accordance with manufacturer's instructions.

8 GENERAL COMMENTS

When the plans and specifications are complete, or if significant changes are made in the character or location of the proposed building, a consultation should be arranged to review the changes with respect to the prevailing soil conditions. At that time, it may be necessary to submit supplementary recommendations.

It is recommended that the services of Cook, Flatt & Strobel Engineers be engaged to test and evaluate the compaction of any additional fill materials and to test and evaluate the bearing value of the soils in the footing excavations.

Respectfully submitted,

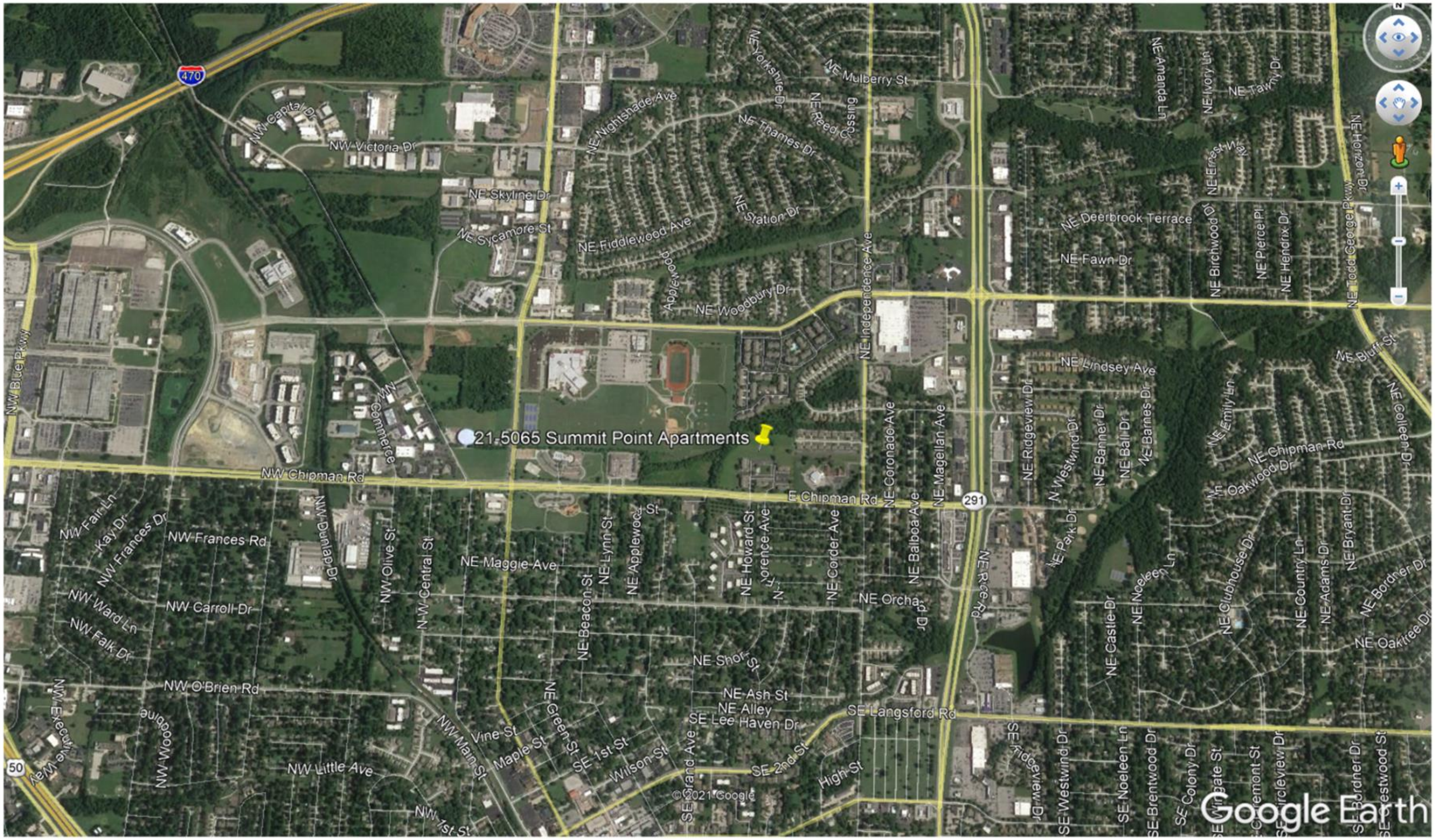
COOK, FLATT & STROBEL ENGINEERS, P.A.

STATE OF MISSOURI
JACOB PHILLIP ENGLER
NUMBER
PE-2017018964
2/23/21
PROFESSIONAL ENGINEER

Jacob Engler, P.E.
Geotechnical Engineer

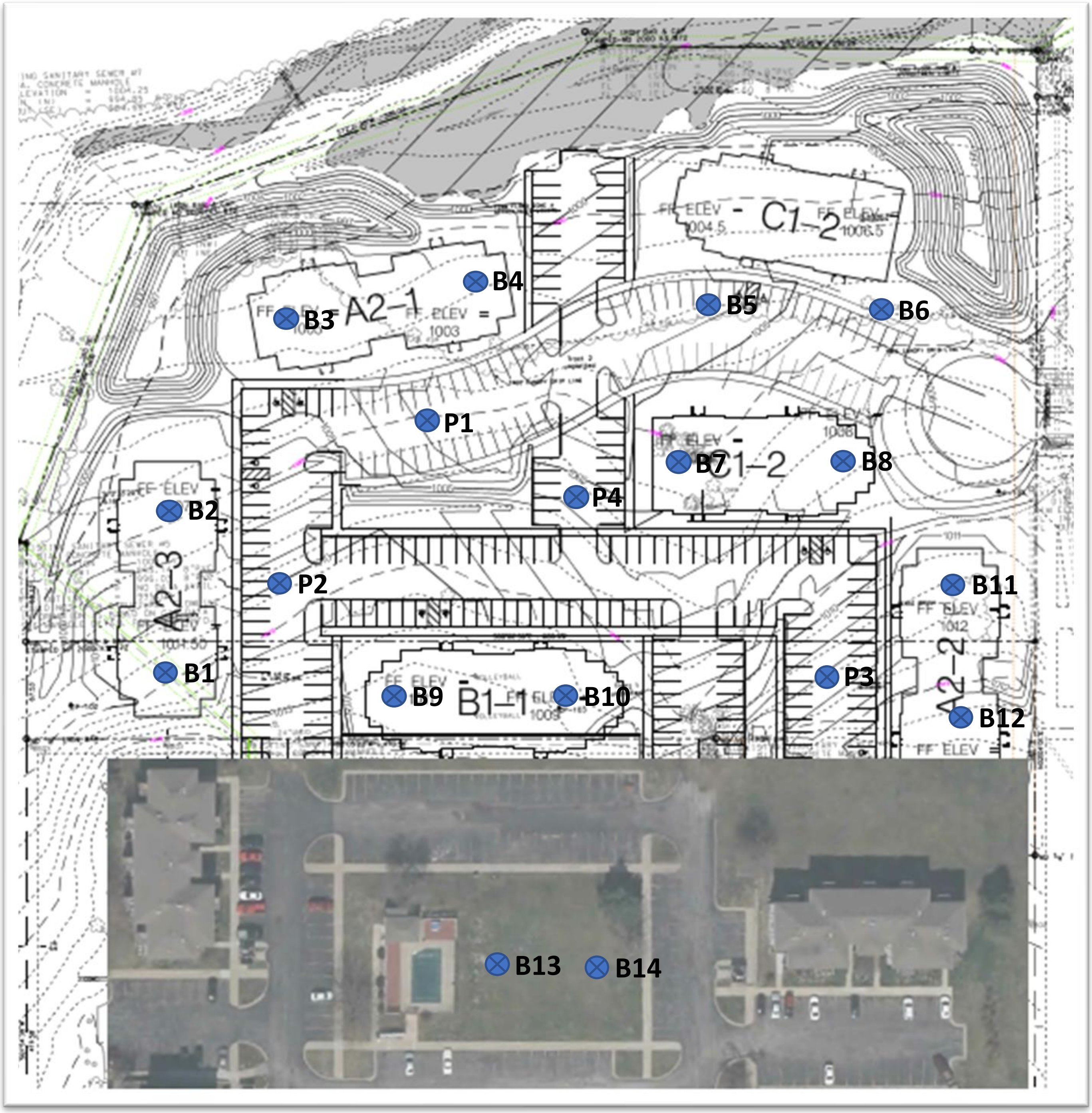
Reviewed by: Adam McEachron, P.E.
Senior Geotechnical Engineer

Appendix A: Figures



CFS ENGINEERS	Project: **SUMMIT POINT**	Project #: 21-5065	Figure 1: **SITE LOCATION PLAN**
	Project Location: Lees Summit, MO	Comments:	
	Client: Canyon View Properties		
	Date: 2/8/2021		

1100 W. Cambridge Circle Dr, Ste 700
Kansas City, Kansas 66103



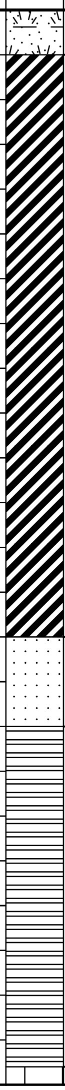
CFS ENGINEERS 1100 W. Cambridge Circle Dr, Ste 700 Kansas City, Kansas 66103	Project: **SUMMIT POINT**	Figure 2:	**BORING LOCATION PLAN**
	Project Location: Lee's Summit, MO	Project #:	21-5065
	Client: Canyon View Properties	Date:	2/8/2021
	Comments		

Appendix B: Boring Logs

CFS Engineers, Inc
1100 W. Cambridge Circle Drive, Suite 700
Kansas City, Kansas 66103

BORING NUMBER B1

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/09/21 **COMPLETED** 02/09/21
GROUND ELEVATION 1009 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
AT TIME OF DRILLING --- No Free Water Encountered
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING --- No Free Water Encountered
NOTES
AFTER DRILLING --- No Free Water Encountered



DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0	ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
	FAT CLAY, (CH) grayish brown, moist, medium stiff, with iron nodules										
		SPT 1	72	2-2-4 (6)	1.25		24				
2.5	(CH) gray and brown, stiff, with trace of fine sand below 3'										
		SPT 2	94	3-4-5 (9)	1.75		24				
5.0											
		SPT 3	89	9-7-36 (43)	1		18				
7.5	SANDSTONE, highly weathered, tan and gray, medium hard										
	SHALE, slightly weathered, tan and gray, with fine sand										
		SPT 4	100	14-22-41 (63)	4.5+		12				
10.0											
	LIMESTONE, moderately weathered										

Refusal at 12.0 feet.
Bottom of borehole at 12.0 feet.

CFS Engineers, Inc
1100 W. Cambridge Circle Drive, Suite 700
Kansas City, Kansas 66103

BORING NUMBER B2

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/09/21 **COMPLETED** 02/09/21
GROUND ELEVATION 1005 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
AT TIME OF DRILLING --- No Free Water Encountered
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING --- No Free Water Encountered
NOTES
AFTER DRILLING --- No Free Water Encountered

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0	ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
	FAT CLAY, (CH) grayish brown and reddish brown, moist, medium stiff, with iron nodules										
		SPT 1	72	2-2-3 (5)	1.25		28				
2.5											
	FAT CLAY, SANDY, (CH) gray and tan, moist, very stiff										
		SPT 2	94	5-8-8 (16)	1.5		21				
5.0											
		SPT 3	100	4-11-15 (26)	2.25		19				
7.5											
	SHALE, slightly weathered, gray and tan										
		SPT 4	100	4-50/6"	4.5+		15				

Refusal at 9.5 feet.
Bottom of borehole at 9.5 feet.

BORING NUMBER B3

CFS Engineers, Inc
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Kansas City, Kansas 66103

CLIENT Canyon View Properties

PROJECT NAME Summit Point Phase II Final Design

PROJECT NUMBER 21-5065

PROJECT LOCATION

DATE STARTED 02/09/21 **COMPLETED** 02/09/21

GROUND ELEVATION 1002 ft **HOLE SIZE** 3.25 inches

DRILLING CONTRACTOR CFS Engineers

GROUND WATER LEVELS:

DRILLING METHOD 3.25-inch Continuous Flight

AT TIME OF DRILLING --- No Free Water Encountered

LOGGED BY TP **CHECKED BY** JE

AT END OF DRILLING --- No Free Water Encountered

NOTES

AFTER DRILLING --- No Free Water Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		LEAN CLAY, (CL) dark brown, moist, soft, with roots	SPT 1	72	0-1-2 (3)	1		30	46	25	21	
2.5		FAT CLAY, (CH) dark grayish brown, stiff										
			SPT 2	61	1-3-5 (8)	2.25		22				
5.0												
			SPT 3	89	2-4-4 (8)	1.5		23				
7.5		SHALE, highly weathered, gray and tan										
			SPT 4	53	3-4-6 (10)	4.5		20				
10.0												
12.5												
		SHALE, slightly weathered, gray	SPT 5	100	22-50/6"	4.5+		16				

Refusal at 14.5 feet.
Bottom of borehole at 14.5 feet.

CFS Engineers, Inc
1100 W. Cambridge Circle Drive, Suite 700
Kansas City, Kansas 66103

BORING NUMBER B4

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/09/21 **COMPLETED** 02/09/21
GROUND ELEVATION 1000 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
AT TIME OF DRILLING --- No Free Water Encountered
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING --- No Free Water Encountered
NOTES
AFTER DRILLING --- No Free Water Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		FAT CLAY, (CH) dark gray, moist, medium stiff, with roots	SPT 1	67	2-2-4 (6)	2.25		25				
2.5		(CH) gray and brown, stiff, below 3'										
			SPT 2	83	2-4-4 (8)	3.25		23				
5.0												
			SPT 3	88	3-3-50/5"	3.5		23				
7.5		LIMESTONE, highly weathered to slightly weathered										

Refusal at 7.8 feet.
Bottom of borehole at 7.8 feet.

BORING NUMBER B5

CFS Engineers, Inc
1100 W. Cambridge Circle Drive, Suite 700
Kansas City, Kansas 66103

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/10/21 **COMPLETED** 02/10/21
GROUND ELEVATION 1003 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
∇ **AT TIME OF DRILLING** 14.00 ft / Elev 989.00 ft
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING --- Not Recorded
NOTES
AFTER DRILLING --- Not Recorded

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		FAT CLAY, (CH) dark brown, moist, medium stiff, with roots	SPT 1	100	0-3-3 (6)	2		25				
2.5		(CH) stiff below 3'										
			SPT 2	78	2-3-5 (8)	3		22				
5.0												
			SPT 3	92	2-3-3 (6)	1.25		40				
7.5												
			SPT 4	100	2-2-6 (8)	4.25		22				
		SHALE, highly weathered, tan and gray										
10.0												
12.5												
		SHALE, slightly weathered, gray										
	∇		SPT 5	100	26-50/4"	4.5+		16				

Refusal at 14.4 feet.
Bottom of borehole at 14.4 feet.

BORING NUMBER B6

CFS ENGINEERS

CFS Engineers, Inc
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Kansas City, Kansas 66103

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/10/21 **COMPLETED** 02/10/21
GROUND ELEVATION 1004 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
AT TIME OF DRILLING --- No Free Water Encountered
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING --- No Free Water Encountered
NOTES
AFTER DRILLING --- No Free Water Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		FAT CLAY, (CH) gray and brown, moist, medium stiff, with iron nodules										
			SPT 1	56	1-2-3 (5)	2.75		23	60	26	34	
2.5		(CH) stiff below 3'										
			SPT 2	83	2-4-5 (9)	3.5		22				
5.0												
			SPT 3	100	3-3-6 (9)	3		24				
7.5		(CH) medium stiff below 8'										
			SPT 4	100	2-2-4 (6)	2		28				
10.0												
12.5												
		SHALE, moderately weathered, gray										
			SPT 5	100	15-23-50 (73)	4.5		16				
15.0												

Refusal at 15.0 feet.
Bottom of borehole at 15.0 feet.

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BORING NUMBER B7

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/10/21 **COMPLETED** 02/10/21
GROUND ELEVATION 1006 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
AT TIME OF DRILLING --- No Free Water Encountered
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING --- No Free Water Encountered
NOTES
AFTER DRILLING --- No Free Water Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		FAT CLAY, (CH) grayish brown, moist, medium stiff, with roots	SPT 1	94	2-2-4 (6)	3		23				
2.5		(CH) gray and brown, stiff, with iron nodules below 3'										
			SPT 2	100	2-4-5 (9)	3		24				
5.0												
			SPT 3	100	3-3-5 (8)	2.25		31				
7.5												
		LIMESTONE, moderately weathered	SPT 4	100	50/1"	.75		39				

Refusal at 8.6 feet.
Bottom of borehole at 8.6 feet.

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CFS Engineers, Inc
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Kansas City, Kansas 66103

BORING NUMBER B8

CLIENT Canyon View Properties

PROJECT NAME Summit Point Phase II Final Design

PROJECT NUMBER 21-5065

PROJECT LOCATION

DATE STARTED 02/10/21 **COMPLETED** 02/10/21

GROUND ELEVATION 1008 ft **HOLE SIZE** 3.25 inches

DRILLING CONTRACTOR CFS Engineers

GROUND WATER LEVELS:

DRILLING METHOD 3.25-inch Continuous Flight

AT TIME OF DRILLING --- No Free Water Encountered

LOGGED BY TP **CHECKED BY** JE

AT END OF DRILLING --- No Free Water Encountered

NOTES

AFTER DRILLING --- No Free Water Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		FAT CLAY, (CH) grayish brown, moist, stiff, with iron nodules										
			SPT 1	72	2-3-6 (9)	3.75		21				
2.5												
			SPT 2	89	3-5-7 (12)	3.75		22				
5.0												
			SPT 3	100	2-5-6 (11)	4.5+		20				
7.5												
		SHALE, moderately weathered, tan and gray	SPT 4	83	3-50/6"	3.5		21				
		LIMESTONE, moderately weathered										

Refusal at 9.5 feet.
Bottom of borehole at 9.5 feet.

CFS ENGINEERS

CFS Engineers, Inc
1100 W. Cambridge Circle Drive, Suite 700
Kansas City, Kansas 66103

BORING NUMBER B9

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/09/21 **COMPLETED** 02/09/21
GROUND ELEVATION 1013 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
AT TIME OF DRILLING 13.00 ft / Elev 1000.00 ft
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING 12.00 ft / Elev 1001.00 ft
NOTES
AFTER DRILLING --- Not Recorded

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		LEAN CLAY, (CL) grayish brown, moist, medium stiff, with iron nodules and trace of fine sand	SPT 1	33	3-3-4 (7)	3.5		22	36	22	14	
2.5		FAT CLAY, (CH) grayish brown, moist, stiff, with iron nodules										
			SPT 2	94	2-3-5 (8)	3.5		23				
5.0		(CH) medium stiff below 6'	SPT 3	100	3-3-4 (7)	3		28				
7.5		FAT CLAY, SANDY, (CH) brown and gray, moist, stiff	SPT 4	100	2-5-9 (14)	2.5		30				
10.0		SANDSTONE, moderately weathered, tan										
12.5			SPT 5	100	50/1"			18				

Refusal at 13.6 feet.
Bottom of borehole at 13.6 feet.

BORING NUMBER B10

CFS Engineers, Inc
1100 W. Cambridge Circle Drive, Suite 700
Kansas City, Kansas 66103

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/10/21 **COMPLETED** 02/10/21
GROUND ELEVATION 1013 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
AT TIME OF DRILLING --- No Free Water Encountered
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING --- No Free Water Encountered
NOTES
AFTER DRILLING --- No Free Water Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		FAT CLAY, (CH) gray and brown, moist, medium stiff, with iron nodules										
			SPT 1	78	1-3-4 (7)	2		28				
2.5												
		(CH) stiff, trace of fine sand below 3'										
			SPT 2	83	3-5-6 (11)	3		23				
5.0												
			SPT 3	100	3-4-5 (9)	1.75		28				
7.5												
		SHALE, moderately weathered, tan and gray, with fine sand	SPT 4	100	3-15-50 (65)	1.75		14				
10.0												
		LIMESTONE, moderately weathered										

Refusal at 10.5 feet.
Bottom of borehole at 10.5 feet.

BORING NUMBER B11

CFS ENGINEERS

CFS Engineers, Inc
1100 W. Cambridge Circle Drive, Suite 700
Kansas City, Kansas 66103

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/10/21 **COMPLETED** 02/10/21
GROUND ELEVATION 1012 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
AT TIME OF DRILLING --- No Free Water Encountered
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING --- No Free Water Encountered
NOTES
AFTER DRILLING --- No Free Water Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		FAT CLAY, (CH) gray and brown, moist, medium stiff, with iron nodules	SPT 1	72	2-3-4 (7)	2		30	51	27	24	
2.5		(CH) stiff below 3'										
			SPT 2	89	3-4-5 (9)	3.75		21				
5.0												
			SPT 3	89	3-5-7 (12)	3.75		25				
7.5												
		SHALE, slightly weathered, gray and tan, with fine sand	SPT 4	96	3-50/6"	2		32				
		LIMESTONE, highly weathered										

Refusal at 9.5 feet.
Bottom of borehole at 9.5 feet.

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Kansas City, Kansas 66103

BORING NUMBER B12

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/10/21 **COMPLETED** 02/10/21
GROUND ELEVATION 1015 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
AT TIME OF DRILLING --- No Free Water Encountered
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING --- No Free Water Encountered
NOTES
AFTER DRILLING --- No Free Water Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		FAT CLAY, (CH) grayish brown, moist, stiff, with iron nodules										
			SPT 1	78	1-3-5 (8)	1.5		29				
2.5												
		(CH) trace of fine sand below 3'										
			SPT 2	92	2-3-5 (8)	2.75		22				
5.0												
			SPT 3	100	4-4-7 (11)	3.25		26				
7.5												
		SHALE, highly weathered, tan, with fine sand	SPT 4	100	4-10-26 (36)	3.75		18				
10.0												
12.5												
		LIMESTONE, moderately weathered										

Refusal at 13.5 feet.
Bottom of borehole at 13.5 feet.

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BORING NUMBER B13

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/10/21 **COMPLETED** 02/10/21
GROUND ELEVATION 1023 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
▽ **AT TIME OF DRILLING** 14.00 ft / Elev 1009.00 ft
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING --- Not Recorded
NOTES
AFTER DRILLING --- Not Recorded

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0	ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
	LEAN CLAY, (CL) dark brown, moist, medium stiff	SPT 1	67	2-3-4 (7)	2.75		32	41	23	18	
2.5	FAT CLAY, (CH) gray and brown, moist, stiff, with iron nodules										
		SPT 2	89	3-3-5 (8)	2.5		24				
5.0		SPT 3	100	3-5-7 (12)	3.25		25				
7.5		SPT 4	100	3-3-6 (9)	2.5		27				
10.0											
12.5	SHALE, highly weathered, tan										

Refusal at 14.0 feet.
Bottom of borehole at 14.0 feet.

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BORING NUMBER B14

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/10/21 **COMPLETED** 02/10/21
GROUND ELEVATION 1019 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
AT TIME OF DRILLING --- No Free Water Encountered
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING --- No Free Water Encountered
NOTES
AFTER DRILLING --- No Free Water Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		FAT CLAY, (CH) dark brown, moist, stiff, with roots	SPT 1	61	3-4-6 (10)	4		24				
2.5		(CH) gray and brown, with iron nodules and trace of fine sand below 3'										
			SPT 2	67	3-6-7 (13)	4.5+		18				
5.0												
			SPT 3	94	3-4-7 (11)	2		25				
7.5												
		SHALE, highly weathered, tan	SPT 4	100	3-10-19 (29)	3		14				
10.0												
12.5												
			SPT 5	100	38-50/5"	3.25		17				

Refusal at 14.4 feet.
Bottom of borehole at 14.4 feet.

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BORING NUMBER P1

CLIENT Canyon View Properties

PROJECT NAME Summit Point Phase II Final Design

PROJECT NUMBER 21-5065

PROJECT LOCATION

DATE STARTED 02/09/21 **COMPLETED** 02/09/21

GROUND ELEVATION 1004 ft **HOLE SIZE** 3.25 inches

DRILLING CONTRACTOR CFS Engineers

GROUND WATER LEVELS:

DRILLING METHOD 3.25-inch Continuous Flight

AT TIME OF DRILLING --- No Free Water Encountered

LOGGED BY TP **CHECKED BY** JE

AT END OF DRILLING --- No Free Water Encountered

NOTES

AFTER DRILLING --- No Free Water Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		FAT CLAY, (CH) dark grayish brown, moist, medium stiff	SPT 1	78	2-2-4 (6)	1.5		26				
2.5		(CH) gray and brown, stiff, with iron nodules below 3'										
			SPT 2	89	3-4-6 (10)	3		24				
5.0												

Bottom of borehole at 5.0 feet.

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BORING NUMBER P2

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/09/21 **COMPLETED** 02/09/21
GROUND ELEVATION 1008 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
AT TIME OF DRILLING --- No Free Water Encountered
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING --- No Free Water Encountered
NOTES
AFTER DRILLING --- No Free Water Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		FAT CLAY, (CH) grayish brown, moist, stiff, with iron nodules										
			SPT 1	78	2-4-5 (9)	3.25		24				
2.5												
			SPT 2	94	3-3-5 (8)	3.5		22				
5.0												

Bottom of borehole at 5.0 feet.

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BORING NUMBER P3

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/10/21 **COMPLETED** 02/10/21
GROUND ELEVATION 1013 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
AT TIME OF DRILLING --- No Free Water Encountered
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING --- No Free Water Encountered
NOTES
AFTER DRILLING --- No Free Water Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		FAT CLAY, (CH) grayish brown, moist, stiff, with iron nodules										
			SPT 1	61	2-2-6 (8)	3		29				
2.5												
			SPT 2	100	2-3-6 (9)	2.75		23				
5.0												

Bottom of borehole at 5.0 feet.

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BORING NUMBER P4

CLIENT Canyon View Properties
PROJECT NAME Summit Point Phase II Final Design
PROJECT NUMBER 21-5065
PROJECT LOCATION
DATE STARTED 02/10/21 **COMPLETED** 02/10/21
GROUND ELEVATION 1008 ft **HOLE SIZE** 3.25 inches
DRILLING CONTRACTOR CFS Engineers
GROUND WATER LEVELS:
DRILLING METHOD 3.25-inch Continuous Flight
AT TIME OF DRILLING --- No Free Water Encountered
LOGGED BY TP **CHECKED BY** JE
AT END OF DRILLING --- No Free Water Encountered
NOTES
AFTER DRILLING --- No Free Water Encountered

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	ATTERBERG LIMITS PLASTIC LIMIT	ATTERBERG LIMITS PLASTICITY INDEX	FINES CONTENT (%)
0.0		ORGANIC SOIL, (OL) dark brown, dry, (TOPSOIL)										
		FAT CLAY, (CH) grayish brown, moist, medium stiff, with iron nodules										
			SPT 1	56	2-2-4 (6)	2.5		29				
2.5												
			SPT 2	89	2-2-4 (6)	2		29				
5.0												

Bottom of borehole at 5.0 feet.