APPENDIX E

Geotechnical Investigation Report

Geotechnical Investigation,
Proposed Steven D. Dorfman Center,
South Campus,
California Lutheran University,
City of Thousand Oaks, California

W.O. 8491
April 29, 2019

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April 29, 2019
W.O. 8491

California Lutheran University
Facilities Operations and Planning
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Attention: Ms. Christine Cano

SUBJECT: Geotechnical Investigation Report,
Proposed Steven D. Dorfman Center,
South Campus, California Lutheran University,
City of Thousand Oaks, California

Ms. Cano:

In accordance with your request, our firm has undertaken a study of the geotechnical conditions at the subject property (Plate 1.1). The proposed project consists of the construction of the New Management School Building north of the existing Ahmanson Science Center (ASCI). Our purpose was to evaluate the distribution and engineering characteristics of the earth materials that occur at the site so we might assess their impact upon the project.

The scope of work for this project included the following tasks:

- review of previous work, which was judged both pertinent to our purpose and readily available to our office;
- logging of three Cone Penetrometer Test (CPT) soundings;
- logging and sampling of one exploratory boring excavated with a truck-mounted hollow-stem auger drill rig;
- selected laboratory testing of the retrieved samples;
- geologic and soil engineering analysis of the assembled data;
- preparation of this report.

Field data and approximate locations of the exploratory excavation and CPT soundings are shown on the enclosed Geologic Map (Plate 1.2). Descriptions of the materials encountered in the exploratory excavations are included in Appendix A. Laboratory test results from our investigations are provided in Appendix B. Our findings are presented in the following sections, followed by a discussion of these findings and geotechnical recommendations.

PROPOSED PROJECT

The proposed project includes, but is not limited to, constructing a two story Management building. Minor concrete flatwork, drainage and landscaping improvements are anticipated to the north, south, east, and west of the proposed building. The project will replace the existing Nygreen Hall Building. The location of this planned building and other improvement is illustrated on a site plan prepared by Jensen Design & Survey, Inc., which is the base for the Geologic Map, Plate 1.2.

The planned building will be a 27,000-square-foot two-story moment frame building with a concrete composite floor deck and a metal stud skin. Based on the site plan prepared by Jensen Design & Survey, Inc., the finish-floor elevations will range from 776.3 feet in the north to 778.3 feet to the south. Preliminary column loads to the foundations are expected to range from 18 kips to 256 kips for columns. No information on wall loads to continuous foundations was provided, but for purposes of this report, it is assumed there may be continuous foundations with vertical loads as much as 4 kips per linear foot. If, during the design phase, estimated loads to the foundations exceed these values, our office should be notified. Further evaluation and supplemental geotechnical design criteria may be warranted in such a case.

At the time of this writing, foundation types have not been finalized. This investigation will address the option of using either shallow spread foundations or deep cast-in-place foundations.

SITE DESCRIPTION

The subject property is located south of Memorial Parkway and east of Pioneer Avenue (Plate 1.1). The site is currently occupied by the existing Nygreen Hall building. The site is bounded to the south by a patio, existing Jamba Juice building, and beyond that, the Ahmanson Science Building. These features are at elevations ranging from 779 to 780 feet. To the north is a grassy knoll extending down to Memorial Parkway at elevations ranging from 769 to 772 feet. To the east is the fire access/concrete walkway with large rectangular brick planters and to the west is Peters Hall at an elevation of about 774 feet. On the site there are existing concrete pathways between landscaped areas with small bushes and trees.

Topographically, the site is relatively flat except for the grassy knoll which slopes to the north and has approximately five feet of relief. Peters Hall sets about five feet lower than Nygreen Hall, utilizing both slope and retaining wall to facilitate the change in grade. In addition, there are multiple utility lines (water, electrical, etc.) in the area of the proposed building.

PREVIOUS STUDIES

No record of geotechnical studies were found for this specific site. This location was the original site of the Pederson ranch house built in 1913. A well and pump house was adjacent to this location to the south, based on available photographs. Citrus orchards surrounded the site when the ranch was operational. The Pederson house was moved to its current location in 1986. Nygreen Hall was constructed and dedicated in April 1973.

Several geotechnical studies have been performed by this office within the south campus area (Plate R). The closest to the subject site was the study for the New Science Building currently under construction, which is located approximately 250 feet to the south of the site (GWV, September 1, 2015), and the Ullman Commons, approximately 250 feet north (GWV, July 29, 2011). Collectively, these investigations include 14 exploratory borings.

FIELD INVESTIGATION

Our office drilled one exploratory boring (B1.MB) and conducted three Cone Penetrometer Test (CPT) soundings to evaluate the engineering properties of the soils in the area of the current proposed building. The exploratory boring was drilled using a CME-75 mobile truck-mounted drill rig with an eight inch diameter hollow stem auger. Samplers were driven with a 140 lb. automatic hammer lifted 30 inches. The samples consisted of a lined California split spoon (2.375 inch id.) and Standard Penetration Test sampler. Both relatively undisturbed ring and disturbed (bulk) samples were obtained at various depth intervals from each boring. These samples were secured and transported to our laboratory for testing.

The CPT soundings were performed using a truck-mounted hydraulic press. The cone tip has a 15 cm^2 surface area and contains electronic monitors for tip pressure, side friction, and pore water pressure. The CPT was pushed to depths of 50 feet below the ground surface, or to refusal on hard material, whichever was encountered first.

LABORATORY TESTING

Undisturbed and bulk samples of materials encountered at the site were collected during the course of our field work. Laboratory tests completed on the retrieved samples are described at the beginning of Appendix B. A comprehensive summary of laboratory test results is provided Appendix B.

GEOLOGIC SETTING

Regionally the site is located in the Western Transverse Ranges of Southern California. The Transverse Ranges are essentially east-west trending elongate mountain ranges and valleys that are geologically complex. Structurally, the Transverse Ranges reflects the north-south compressional forces that are the result of a bend in the San Andreas Fault that delineates the collision zone between two tectonic plates. As the Pacific Plate (westerly side of the fault) and the North American Plate (easterly side) move past one another along the fault the bend creates a deflection which allows for large accumulations of compressional energy. Some of this energy is spent in deforming the crust into roughly east-west trending folds and secondary faults. The most significant of these faults are typically reverse or thrust faults, which allow for the crustal shortening taking place regionally.

The subject site is located within the Ventura Basin province which is the dominant structural element of the Western Transverse Ranges. The Ventura basin and its offshore continuation in the Santa Barbara Channel are filled with a thick sequence of Cenozoic rocks estimated to be more than 20,000 feet in total thickness. More locally, the site is within the northernmost portion of the Conejo Valley. The subject site is surrounded by Miocene age volcanic bedrock locally known as the Conejo Volcanics. The bedrock in the area of the subject site typically consists of basalt and andesite flows with variable amounts of agglomerate. The broad alluviated valleys directly adjacent to the Conejo Volcanics generally consist of consolidated to over-consolidated clay rich soils. This site is situated in such an alleviated valley.

EARTH MATERIALS

Descriptions of the earth materials encountered within our exploratory borings are provided below. More detailed descriptions may be found in the enclosed boring logs in Appendix A. We have prepared a Geologic Map presented on Plate 1.2, which provides a generalized distribution of the geologic units and the locations of the exploratory excavations.

Artificial Fill

Visual observations within the upper approximately 3 feet of the exploratory boring indicate artificial fill is present directly beneath the existing surface. Given the preponderance of underground utilities, there may be localized areas of fill that are approximately five feet deep. Due to the limited thickness it was not formally logged on the exploratory boring logs. The artificial fill materials were most likely placed during past development or demolition at the site. Artificial fill at the building location is not considered suitable for support of the proposed structure.

Alluvium

The Quaternary-age alluvial deposits on the site were encountered approximately in the upper 12 feet of the soil profile and generally consisted of light yellowish brown lean CLAY sandy SILT and silty SAND (ML/SM). This material is generally very stiff/dense and moist to very moist.

Older Alluvium

The older alluvial deposits on the site were encountered below depths of 12 feet and generally consisted of light grayish brown and light grayish white CLAY (CH) and lean CLAY (CL) with/without sand and silt. This material is generally very stiff to hard and moist to very moist.

GROUNDWATER

Groundwater was encountered in boring B1 at a depth of eighteen feet. This corresponds to a groundwater elevation beneath the site being approximately between 754 feet above mean sea level. Groundwater was also encountered during our previous exploration of the New Science Building (GWV 2015) at depths of 25 and 30 feet, and during construction at approximately elevation 744 feet. During investigation for the Ullman Commons groundwater was noted at approximately elevation 742 feet. This data suggests a local groundwater high in the area of the Nygreen/Ahmanson buildings.

The materials sampled above and below the groundwater had moistures in the range of 12 to 40 percent of the materials dry unit weight. This correlates to degrees of saturation ranging from 91 to 100 percent.

STORMWATER INFILTRATION

It is our opinion that infiltration of stormwater in this portion of the campus is not a suitable means of compliance with the Ventura County MS4 permit. The near surface soils are mapped as Ventura County Soil Number 1 (see Plate 1.3). Per the Ventura County Technical Guidance Manual for Stormwater Quality Control Measures, errata update 2015 (TGM), infiltration-based BMPs should not be designed for such sites.

Furthermore, the soils at depth do not appear to be a suitable candidate for an infiltration-based BMP. As discussed in the earth materials section above, and in the investigation report for the new science building (GWV, 2015), the subsurface soils consist predominantly of clay with lesser amounts of clayey sand. Grain size analyses and manual descriptions of the onsite soils indicate the majority are comprised of clay loam to silty clay loam (NRCS Group D), with relatively thin and laterally discontinuous interlayers of sandy loam to loam (NRCS Groups A and B). Per the TGM, infiltration type BMPs is not appropriate in Group D soils. The Group A and B soils onsite are thin, discontinuous, and underlain by Group D soils. We anticipate an infiltration type BMP with an invert in these layers would quickly saturate and experience a very significant reduction in functionality. In addition, any infiltrated water would likely perch on an underlying low permeability Group D layer. Given the limited thickness of the Group A and B soils, it is extremely unlikely that an adequate vertical setback can be achieved from the perched groundwater level. For these reasons it is our opinion that infiltration of stormwater onsite is not a feasible means of compliance with the Ventura County MS4 permit.

FAULTING AND SEISMICITY

The subject site contains no known active or potentially active faults, nor is it within an Earthquake Fault Zone. Therefore, the potential for ground rupture is considered to be very low. However, the property is situated within the seismically active Southern California region and ground shaking is likely to occur due to earthquakes caused by movement along nearby faults.

Regional Faults

Two fault systems that are relatively close to the site have been included in the Earthquake Fault Zone maps by the State of California. They are the Santa Rosa Valley Fault Zone and the Simi-Santa Rosa Fault (FER-244) (see the following Figure 1). The closet surface trace of a splay associated with the Santa Rosa Valley Fault Zone is approximately 1.5 miles to the northwest of the property. The closet surface trace of the Simi-Santa Rosa Fault is approximately 2.2 miles to the north/northwest of the property. Both of these faults are considered to have been active during Holocene time (past 11,000 years) and are considered to have the potential for surface rupture.

Historical Seismicity

Research has been performed to estimate the impact of historic earthquakes on the subject site. The software entitled EQSEARCH v.300 (Blake, 2000) for Windows was utilized to provide a summary of historical earthquakes with a time period search of 201 years (1800-2000), epicenters within 100 miles of the site (and magnitudes greater than M=4.0) and their estimated ground shaking intensity (per the Modified Mercalli Intensity, MMI) at the subject site. Output is provided in Appendix D and summarized herein.

The earthquake closest to the site was found to be 9.5 miles away. The largest earthquake acceleration for the site was found to be 0.216g. The highest ground shaking intensities estimated for the site is (MMI=VIII).

Six historical earthquakes (one of which includes the Northridge earthquake which occurred on January 17, 1994) are estimated to have resulted in a ground shaking intensity on the MMI scale of VIII at the site. An MMI of VIII is described below:

A Modified Mercalli Intensity of VIII corresponds to *"Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture moved."*

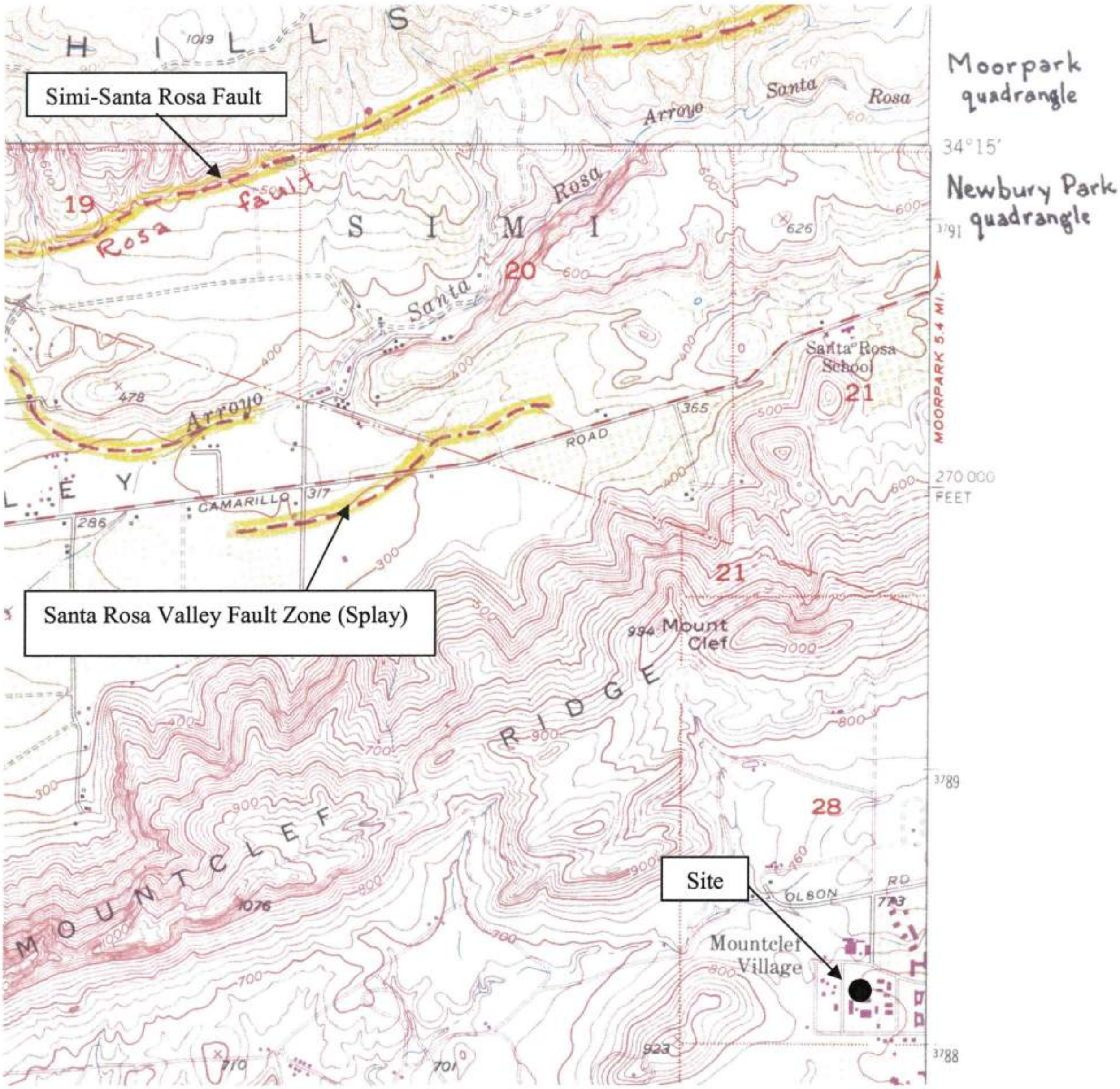

Figure 1. Taken from a Portion of CDMG Fault Evaluation Report FER- 244 Simi-Santa Rosa Fault Zone, Ventura California (see Plate 1.3 for official map)

California Building Code (CBC) Site Class

The site is underlain by very stiff/hard and dense alluvium. Blow counts obtained in the upper 30 feet by standard penetration tests ranged from 9 to 40 blows per foot and averaged 20 blows per foot in borings B1. It is anticipated that soils with a similar Standard Penetration Resistance as encountered at or near depths of 30 feet continue below 30 feet. According to Section 1613.3.2 of the 2013 CBC, Site Class D is appropriate to model the materials on the project site.

Seismic Ground Motion Values

This report includes preliminary seismic ground motion values in accordance with the 2016 CBC (California Building Code). This code addresses seismic design based on response spectra considering an earthquake with a 2% probability of exceedance in 50 years (2475 year return period). Seismic ground motion values were determined in accordance with the procedure within CBC §1613.3 using the SEA/OSHPD web tool. Output from these analyses are provided in Appendix C and summarized herein.

Latitude: 34.2228º Longitude: -118.879º	**Factor/Coefficient**	**Value**
Site Profile Type	Site Class	D
Short-Period MCE at 0.2s	S_s	1.938
1.0s Period MCE	S_1	0.721
Site Coefficient	F_a	1.000
Site Coefficient	F_v	1.500
Adjusted MCE Spectral Response Parameters	S_{ms} S_{m1}	1.938 1.082
Design Spectral Acceleration Parameters	S_{DS} S_{D1}	1.292 0.721
Peak Ground Acceleration	PGA_M	0.725

LIQUEFACTION

Liquefaction is a condition where the coarse-grained soil undergoes continued deformation at a constant low residual stress due to the build-up of high porewater pressures. The possibility of liquefaction occurring at a given site is dependent upon the occurrence of a significant earthquake in the vicinity; sufficient groundwater to cause high pore pressures; and on the grain size, relative density, and confining pressures of the soil at the site.

The subject site, like other sites in Southern California, is expected to be subjected to significant shaking from earthquakes. Review of the CDMG Seismic Hazard Zone Map for Newbury Park Quadrangle (Plate 1.4) indicates the site is not within an area mapped as having a historic occurrence of liquefaction or conditions that indicate a potential for permanent ground displacement. The soils are very stiff and cohesive (i.e. clayey) which supports the map designation by CDMG. These materials are considered to have a low potential for liquefaction.

SEISMICALLY INDUCED SETTLEMENT

During seismic ground shaking, seismically induced settlement can occur. Considering the stiff to hard clayey subsurface soils, we consider there to be a low potential for seismic settlement.

HYDROCONSOLIDATION POTENTIAL

Hydroconsolidation is a condition where dry or moist soils undergo settlement upon being wetted. In many cases no additional surcharge load is necessary to trigger the hydroconsolidation.

The potential for hydroconsolidation is best evaluated based upon the results of consolidation tests performed on samples taken from borings. Based on our review of the data collected, the samples typically expanded upon the introduction of water under a normal load approximating their current vertical overburden load. The boring logs indicate that the large majority of the alluvial deposits have significant clay content that accounts for the observed expansion. Accordingly, considering all the available data, we consider the alluvial materials to have a low potential for hydroconsolidation.

DISCUSSION AND RECOMMENDATIONS

Data from our field exploration, laboratory testing, engineering analyses, and review of reference reports, coupled with inferred conditions about our exploratory excavations, is the basis for the following discussion. Recommendations, based upon the presently available data, are presented for your consideration.

To date, buildings on campus have been supported by either shallow conventional spread foundations or deep cast-in-place foundations. The findings from this investigation indicate both foundation types are appropriate for the geotechnical conditions at the site, but the planned building should not use a mix of the two types.

The field investigation had limited access due to the presence of the existing buildings, utilities, and flatwork. During the construction of the nearby science center, significant roots were encountered during grading. We recommend that after the Nygreen building is removed, additional exploratory test pits be performed to evaluate the presence of shallow roots. The presence of roots could affect the scope and cost of the grading construction.

Expansive Soils

Laboratory testing indicates that the on-site soils have a high expansion index (91-130) with respect to expansion potential. The application and maintenance of proper drainage and irrigation techniques will be crucial in the performance of improvements, most notably slab-on-grade and flatwork construction.

The building code addresses mitigation options such as: (1) design foundations to penetrate or resist the expansive soils, (2) design for the expansive condition (methods such as Post-Tension-Institute), (3) removal of expansive soil, or (4) stabilization of expansive soil. Considering the type of construction and our experience with expansive soils in this area, recommendations have been provided for shallow foundation types such as conventional spread foundations constructed in conjunction with pre-saturation of the supporting subgrade soils, post-tensioned foundations, and deep foundations consisting of cast-in-place piles.

A final testing for expansion indices should be performed for each structural area at the conclusion of grading.

Removals and Fill Caps

Specific removal depths and fill cap criteria will depend on foundation types and anticipated loads, past soil disturbance, as well as the location of the future structures. Testing indicated the native soils are expansive. Demolition of the existing Nygreen building is anticipated to cause disturbance of shallow soil. Construction of compacted fill caps is considered appropriate to increase uniformity of foundational support, moisture content, and expansion potential in the near surface soils.

Generally, for those structures with wall loads on the order of 4 kips per linear foot and column loads up to 260 kips, recompaction of the soils on the order of 3 feet below proposed footings would provide adequate slab support and modest (2000 psf) allowable bearing pressures. Additional excavation and recompaction may be warranted to improve locally disturbed soils, remove organic material and/or to achieve higher allowable bearing pressures below heavily loaded conventional foundations.

For a building scheme that includes deep foundations and slab-on-grade, removals should be sufficient to remove any disturbed soil or organic material from the building area. The slab-on-grade should be supported by non-expansive or low-expansive compacted fill as discussed later in this report.

Grading - Engineered Fills

The following recommendations pertain to the placement of, and preparation for, engineered fills. These recommendations are general in nature. Specific recommendations should be developed for specific structures.

1. The on-site soils are suitable for use as structural fill. However, soils bearing organic material, or other debris should be wasted from the site. Any import materials that are to be used as structural fill should be approved by this office prior to placement.
2. Shrinkage refers to the lesser volume of fill that result from a given volume of excavation. Overall shrinkage is anticipated to be between 5% and 10%.
3. Subsidence includes the general lowering of the ground due to in-place compaction by construction equipment. Subsidence is anticipated to be on the order of 1.0 tenth of a foot.
4. All vegetation, trash debris or other deleterious material should be stripped from the area to be graded and wasted from the site. Soils bearing sparse grasses may be thoroughly mixed with at least ten parts clean soil and incorporated into the engineered fill.
5. Compressible soils that lie within the area to be filled should be removed to relatively incompressible material and replaced as properly compacted fill. Portions of the compressible materials that are sufficiently thin may be scarified, watered or air dried to approximately the material's optimum moisture content, and compacted in-place. A combination of removal and recompaction in-place may be used, providing the recommended compaction is obtained throughout the recommended depth interval.
6. The maximum dry density and optimum moisture content of the material to be used as compacted fill should be determined in accordance with the standard test method ASTM D1557 ("modified proctor"). The density of earth materials is to be measured using the nuclear gauge (ASTM D6938) or sand cone (ASTM D1556) test methods. The frequency of field density tests should be at least one density test for every 1,000 cubic yards of fill or each 18 vertical inches of fill.

7. Exposed surfaces should be scarified, moistened or air dried as appropriate, and compacted to at least 90% of the material's maximum dry density prior to placement of fill.
8. We recommend a uniform blanket of compacted fill be created for support of structural footings (for buildings and retaining walls with conventional foundations). The fill cap should extend to at least three feet below the base of proposed footings and five feet beyond their perimeter. Special consideration should be paid to locations where existing improvements (utilities, power poles, etc.) interfere with the creation of the desired fill cap. Such conditions should be brought to the attention of this office so that the specific site conditions may be evaluated and recommendations provided.
9. Fill materials should be placed in thin lifts not exceeding approximately eight inches (compacted) in thickness, watered to near the material's optimum moisture content, and compacted to at least 90% relative compaction prior to placing the next lift.
10. The 90% relative compaction standard applies to the face of fill slopes. This may be achieved by overfilling the constructed slope and trimming to a compacted finished surface, rolling the slope face with a sheepsfoot, or any method that achieves the desired product.
11. All grading should comply with the grading specifications and requirements of the local governing agency.

Temporary Excavations

Temporary excavations (such as backcuts for removals, and retaining wall excavations) may be considered stable if cut vertical, providing they are restricted to a maximum of 5 feet in height, are provided with permanent support as soon as possible, and they are protected from erosion and saturation. Portions of temporary excavations in excess of 5 feet high should be laid back to a gradient of 1:1 or flatter unless specific alternative treatments are evaluated and found acceptable.

Foundation Systems

The soil at the site is considered to have a high potential for expansion/shrinkage with changes in moisture. The use of either conventional shallow spread foundations or post-tension foundations, or deep foundations is considered appropriate for these soil conditions. The following sections provide recommendations for these foundation systems.

Conventional Foundation Systems

Continuous or pad footings may be used to support the proposed structures and/or accessory structures. In order to achieve the capacities specified below, they should be founded a minimum of 27 inches into engineered fill for exterior footings and 18 inches for interior footings, with the concrete placed against in-place, undisturbed material. Foundation design criteria are based, in part, upon the expansive properties of the materials present near the finished pad grade. Laboratory testing to verify the expansive properties of the near-pad-grade materials should be performed at the completion of rough grading.

Pre-saturation guidelines are presented in the following table. Pre-saturation of the foundation soils should be initiated well before concrete is scheduled to be placed. Care should be taken to see that the water has properly penetrated the soil. Last minute flooding is not a good practice. Excess water remaining in the target pre-saturation zone at the time of concrete placement will penetrate further into the soil, possibly causing additional expansion and uplift of the curing concrete.

A persistent difficulty in attaining the desired pre-saturation is the tendency to deeply saturate soil below footings when trying to achieve saturation of the soil beneath the floor slabs. Flooding of the footing trenches commonly results in the presence of compressible mud at the bottom of the footing trench. This practice should be avoided. Where such mud is present, it should be removed prior to concrete placement.

Anticipated Expansion Index Range	91-130
Pre-saturation	36"
Footings[(1)]	
Allowable Bearing Capacity	2000 PSF[(2)]
Lateral Resistance	175 PSF/Ft[(2) (3)]
Maximum Lateral Resistance	2000 PSF[(2) (3)]
Coefficient of Friction	0.25
Minimum Embedment Into Foundation Material	12 inches
Minimum Embedment Below Adjacent Grade[(4)]	27 inches
Minimum Reinforcement	4 #4 bars, 2 near top, 2 near bottom

Slabs-On-Grade
Bedding ....6" of clean sand
Thickness ....Full 5"
Minimum Reinforcement[(5)] ....#4 bars @ 16" o.c., e.w.

1. The base of all footings should be at least five feet (measured horizontally) from the face of adjacent, descending slopes. All footings should bear at least three feet below an imaginary plane projected upward at 1.5:1 from the toe of locally over-steepened slopes. Pad footings should be at least 24 inches square. Continuous footings should be at least 12 inches wide for one-story and 15 inches wide for two-story structures.
2. May be increased by 1/3 for short duration loading such as by wind or seismic forces.
3. Decrease by 1/3 when combined with friction.
4. Applies to exterior footings. Interior footing embedment should be 24 inches (three story).
5. Dowel slab to exterior footing using #3 bars @ 36" on center, bent 3' into slab.

Post-Tensioned Foundations

Post-tensioned foundations may be used to support the proposed structures. These foundations are typically designed to resist deformation related to expansive soils. The recent building code (2013 CBC) references the design methodology within the PTI publication "Standard Requirements for Analysis of Shallow Concrete Foundations on Expansive Soils" which is based on the PTI publication "Design of Post-Tensioned Slabs-on-Ground", 3rd Ed.

The following geotechnical parameters were developed using the methodology of the PTI 3rd Ed.

Parameter (**PTI 3rd Ed.)**	EI 0 to 50	EI 51 to 90	EI 91 to 130
E_m Center Moisture Variation Distance	9.0 feet	9.0 feet	9.0 feet
E_m Edge Moisture Variation Distance	6.1 feet	5.9 feet	5.2 feet
Y_m Center Lift	0.46 in	0.45 in.	0.75 in.
Y_m Edge Lift	0.78 in	0.75 in.	1.3 in.

These parameters attempt to address the typical soil characteristics for the soils in the expansion index grouping using statistical averages of a variety of soil properties. The design criteria are considered minimums and may not be adequate to represent worst-case conditions such as adverse drainage and/or improper landscaping and maintenance. Additional protection may be provided by adjusting the parameters for sources of moisture variation such as flower beds, lawns, and trees. This is discretionary. Additional parameters for this modification can be provided upon request.

PTI values have been prepared considering the deepened edges noted in the following table. Deepened perimeter edges of different depth will have an impact on the magnitude of the values provided. Other edge depths can be analyzed upon request. The depth of the deepened beams should be no less than specified in the following table. The bottom of the deepened perimeter beams should be designed to resist tension, using cable or reinforcement per the Structural Engineer. Pre-swelling of the soils, in accordance with the following table, must also be used to retard uplift after construction.

Expansion Index	Typical Subgrade Reaction "K" Values (pci)	Exterior Footing Depth	Pre-saturation Depth
91 - 130	40 - 4	27 in.	33 in.

The allowable bearing capacity may be taken as 1000 PSF at pad grade and 1500 PSF at 12 inches embedment and with a minimum width of 12 inches. This may be increased by one-third for short duration loading, such as by wind or seismic forces. Care should be exercised to see that all spoils from the slab subgrade are removed or properly compacted.

Other aspects of the design, including but not limited to minimum reinforcement, footing embedment and the need for interior footings, are to be determined by the project structural engineer. However, cold joints (in deepened footings and/or sunken rooms) should not be allowed.

Settlement of Shallow Foundations

Static settlement of shallow conventional or post-tension foundations is anticipated to be minor, on the order of 1 inch for the anticipated foundation loads. Differential loads between adjacent footings with similar loads are anticipated to be less than one-third inch. Once specific foundation loads and configurations are known, additional refinements to the estimated settlement can be performed.

Cast-in-Place Deep Foundations

The proposed building may be supported on cast-in-place deep foundations. Support for these foundations should be provided below a depth of 13 feet below the subgrade to resist the uplift forces produced by the expansive soil.

Deep Foundation Vertical Capacity

Cast-in-place deep foundations can be cast in drilled holes extending into the existing earth materials. The bearing capacity of these deep foundations was analyzed considering side friction only for vertical capacity. Data from onsite investigation, the investigation for the new science building (GWV, 2015, 2018a), and construction load pile load tests at the new science building (GWV, 2018b) were evaluated to determine the level of uniformity of the earth materials at the two sites. Based on the uniformity of the compiled subsurface information, the data from the science center along with onsite data was used to develop vertical load design criteria for deep foundations for this project. The results indicate allowable skin friction capacity of 750 psf is considered appropriate for the site conditions. The allowable vertical capacity has a factor of safety of two applied to the ultimate side friction values. To achieve the full vertical capacities, deep foundations should be spaced no closer than three pile diameters center-to-center.

Uplift resistance can be derived from side friction along the pile and the weight of the pile. The allowable side friction values used to resist uplift can be developed by applying a factor of safety of three to the ultimate skin friction values. Capacities may be increased by one-third for short duration loading (i.e., by wind and seismic loading). The expansive earth materials can cause uplift if moisture changes in the active zone, considered to extend to a depth of about 13 feet.

Deep Foundation Settlement

The settlement for the proposed cast-in-place deep foundations supported via side friction is not anticipated to exceed ¼ inch of settlement.

Deep Foundation Lateral Capacity

The lateral forces transferred to cast-in-place deep foundations can be resisted by the passive resistance in the underlying native alluvial soils. The lateral performance of deep foundations is dependent upon pile stiffness, embedment depth, pile cap fixity conditions, axial load, the nature of the supporting soils, and the magnitude of lateral deflections allowed.

To analyze the lateral response of deep foundations, the supporting soil is modeled as a series of non-linear lateral springs with the lateral response characterized by p-y curves, using computer software such as LPILE (Ensoft, 2016). The following design parameters can be used in lateral load analyses with a desired head deflection and head fixity to estimate the lateral capacity of the pile/soil system. The soil values are based on exploration, published values, and our past experience. The passive resistance along the pile caps and grade beams may also be used to provide lateral resistance (see foundation section for passive resistance values).

Lateral Design Parameters

Depth Below Grade (ft)	**L-Pile Soil Model**	**Estimated Effective Unit Weight (pcf)**	**Undrained Shear Strength, cu (psi)**	**Static Soil Modulus, k (pci)**	**Strain, E_{50}**
0-22	Stiff Clay w/o Free Water	120	28	---	0.005
>22	Stiff Clay w Free Water	57.6	28	1000	0.005

Deep Foundation Installation

Concrete must be placed in direct contact with the undisturbed in-place materials in order to achieve the specified capacities. Perched groundwater was encountered in the exploratory excavations. During the investigation, caving of the hollow-stem exploratory borings did not occur; however, that may be due to the support provided by the auger. At the new science site, caving did occur below groundwater. It is anticipated that caving will occur in excavations below the groundwater. Stabilization of the excavation is anticipated to be necessary below the groundwater. Methods of stabilization include casing and/or the use of drilling fluids. During the investigation, this cohesive material provided difficulties with cleaning drilling equipment in contact with the soil.

Adjacent deep foundation excavations should not be open at the same time. We recommend deep foundations be completed and the concrete allowed to set-up prior to excavation of an adjacent deep foundation location.

Cast-in-place deep foundations are a non-displacement type of foundation. Their construction will produce spoil materials. Accommodations should be made for removal of this volume of materials from the site.

Building Slabs

Building slabs, when used in conjunction with deep foundations, can be supported via different options. The slabs can be constructed as structural slabs supported by the pile and grade beam system, independent of subgrade. Other options include constructing the slabs on-grade as conventional slabs either tied to the grade beam system or independent of the grade beams (floating). Structural slabs independent of the subgrade requires no special subgrade preparation; however, this system is often more expensive. Design options using slab-on-grade requires improvement to the subgrade soils to reduce their potential for heave/shrinkage with changes in moisture in the soil.

Slab-on-Grade

Slab-on-grade building slabs can consist of conventionally reinforced concrete slab-on-grade. The slabs should be at least four inches thick and reinforced with no less than #4 reinforcement bars spaced at 16 inches on-center in each direction. This criterion is designed to address the subgrade soils. Additional thickness and/or reinforcement may be necessary to address dead and/or live loads. We defer that aspect of the slab design to the project designer.

The subgrade for the slab is anticipated to be highly expansive. This can be addressed by either replacement of this material or pre-saturating this material. For the replacement option, the upper two feet of the subgrade below slab-on-grade should be improved or replaced to reduce the expansion potential. The slab-on-grade should be supported by at least two feet of soil with a plasticity index (PI) of zero, or three feet of soil with a PI of 12 or less. During grading, additional testing of the soil should be performed to confirm in-situ plasticity and prepare final improvement criteria.

For the option of pre-saturation, the subgrade should be pre-saturated prior to placement of the vapor barrier. The depth of saturation is 36 inches as noted in the foundation section of this report.

Six inches of sand should be placed across the slab subgrade, with a vapor retarder placed on top of the sand in all areas where moisture penetration of the slab is undesirable.

The vapor retarder should consist of at least 10 mil thick, polyolefin plastic that complies with specifications in the present version of ASTM E1745. ACI indicates concrete for the floor slab should be placed directly upon the vapor retarder. Common experience in this region is to place blotter sand between the concrete slab foundation and the vapor retarder – typically positioning the retarder at mid height of the sand layer. We recognize the commonly held opinion that Blotters facilitate concrete curing and limits the risk of crazing (shrinkage cracking). On the other hand, we also recognize that use of a Blotter increases the risk of potentially damaging moisture penetration through the slab foundation. Consequently, determining whether to use a Blotter is a choice between competing factors. The choice of the position of the retarder should be discussed and resolved amongst the design team and owner.

The vapor retarder should be placed in general conformance with ASTM E1643. The permeance (propensity to transmit water) and strength (i.e. Class A, B or C) of the vapor retarder, as well as the water/cement ratio, mix design and strength of the concrete, will influence a variety of things, including slab finishing, construction schedules, moisture released from the slab, and floor coverings. Project design and construction professionals should consider these factors when developing specifications for, and/or selecting materials for, the vapor retarder, concrete, and floor covering.

Grade Beams and Pile Caps

Grade beams and pile caps could be acted upon by uplift forces produced by expansion of the subgrade soils. These uplift forces can be eliminated by placing compressive material beneath the grade beam to absorb the uplift stress caused when soil beneath the beams expand. An alternative design is to design the beams, or check the grade beam designs, to account for possible uplift forces. Considering the results of laboratory testing, we anticipate the expansive soils of being capable of producing uplift forces on the order of 3 to 4 kips per square foot.

The grade beams and pile caps may be used to provide lateral resistance. The passive lateral resistance can be assumed to be 175 psf/ft to a maximum lateral resistance of 2000 psf. These values may be increased by 1/3 for short duration loading such as by wind or seismic forces. Friction beneath these elements may use a coefficient of friction of 0.25 acting with the dead load. The passive lateral resistance should be reduced by 1/3 when combined with friction.

Retaining Walls

Conventional Cantilever Walls

Retaining walls may be used within the subject project. Foundation design criteria are provided in the preceding section. Lateral loading criteria for cantilevered wall designs with level backfills are presented in the table below. The loading criteria are in part a function of the type of backfill material. Criteria for various Unified Soil Classification designations are provided. Soil classified as CL predominates the upper materials at the subject site. Lateral earth pressures acting on the wall may be reduced by replacement of these soils, throughout the backfill-backslope area that influences wall design with less expansive soils. The zone of influence extends from the back of the wall to a line project upward at about 45 degrees from the back of the footing to the ground surface. Earth materials for backfill and bearing support may be assumed to have a total soil unit weight of 125 pcf.

Lateral Design

	Equivalent Fluid Density (PCF)(1)			
USCS Class:	GW, GP, SW, SP	GC, GM, SM	SM-SC, ML	SC, CL-ML, CL
Active Pressure	30	45	45	60
At-rest Pressure	60	60	100	100

(1) Based on Table 1610.1 of the 2013 CBC. Special design required for wall height in excess of fifteen feet.

Retaining walls that are free to deflect may be designed for active pressure. Retaining walls that are restrained should be designed for at-rest pressure. The 2013 CBC §1610 allows basement walls which extend not more than 8 feet below grade with supporting flexible floor systems to be designed for active pressure.

For walls supporting slopes steeper than 5:1 (H:V), the equivalent fluid densities in the table should be increased. The values may be increased 1 pcf for each 2 degrees of backfill gradient. For example, ascending backfill with a gradient of 2:1 may use an equivalent fluid density that is increased by 13 pcf. Recommendations for other backfill conditions may be provided upon request.

All retaining walls should be provided with adequate backdrainage systems. Either weep holes or pipe outlets should be installed. Free draining material should be used behind weep holes or about pipe drains. Care should be exercised to see that weep holes are installed and maintained above the finish grade adjacent to the face of the wall.

Backfill for retaining walls should be properly compacted. An impervious cap should be provided at the top of the backfill to retard infiltration of water. A typical backfill detail is provided in the Typical Details appendix of this report.

Additional surcharge, such as that due to proposed structures, traffic, hydrostatic pressure, or other loading, should be included in the wall design. Use of expansive soil as backfill for retaining walls will result in a surcharge to the wall, the magnitude of which is dependent upon the expansion index of the backfill.

Seismic Increment of Earth Pressure

As required by California Building Code §1803.5.12 geotechnical reports for structures assigned to Seismic Design Category D, E or F must include information regarding lateral pressures on foundation walls and retaining walls due to earthquake motions. Recent writings such as Lew et al. (2010), Al Atik et al. (2010), and Sitar and Wagner (2015) attempt to address the appropriate means to implement this code requirement. These works conclude in part that seismic earth pressures can be neglected when the peak ground acceleration is below 0.3g. For this site, the peak ground acceleration is considered to be above this threshold.

For retaining walls, the following design criteria are provided considering the general provisional recommendations proposed by Sitar and Wagner (2015) for walls founded on non-saturated, level ground conditions. Per CBC §1803.5.12 item 1, the seismic earth pressure increment need only be included in design when walls support more than six feet of backfill. When this criterion is met, cantilever walls free to move and rotate can be designed for a seismic earth pressure increment considering an equivalent fluid pressure of 15 pcf (triangular pressure distribution). Walls restricted from moving or rotating, such as basement walls, can be designed for a seismic earth pressure increment considering an equivalent fluid pressure of 35 pcf (triangular pressure distribution). The resultant of this seismic earth pressure increment is considered to act at one-third H above the base of the wall. The seismic earth pressure increment should be applied to the active earth pressure for both the free-to-rotate and restrained cases. Often, for the case of walls restricted from moving or rotating, this combination of active earth pressure and seismic earth pressure increment will not exceed the at-rest earth pressure for the static case when considering factored loads used for the basic load combinations prescribed in the California Building Code.

Factors of Safety

The factor of safety for the allowable bearing pressure provided is greater than three. The allowable passive pressure provided is based upon a factor of safety of 1.5. The factor of safety for the sliding friction is one. The factor of safety for the active pressure is one.

With regard to retaining walls, the Building Code calls for a 1.5 factor of safety for both sliding and overturning. We defer to the California Building Code and the project structural engineer on this matter.

Corrosion Potential

Preliminary testing of samples obtained from our borings indicates the on-site soils have low levels of sulfates which indicate a low corrosion potential for concrete. Resistivity tests indicate the soils are corrosive to ferrous metals. Near the completion of grading additional testing should be performed to verify the corrosion potential of the soils

Concrete Flatwork

The soils on the subject property are expansive. These soils are subject to changes in volume with changes in moisture content. The following recommendations are intended to limit the effects of the expansive soils on concrete flatwork.

All flatwork should be designed for an expansive soils condition. Concrete should be a nominal 4 inches thick, and be reinforced with at least 6x6-W2.9x2.9 wire mesh or #3 rebar at 24 inches on centers, each way. Concrete should be underlain by four inches of clean sand or base. The subgrade should be pre-saturated to a minimum depth of 27 inches prior to placement of concrete. Expansion joints should be placed at a spacing of no more than eight feet. Walkways should be designed to be free floating, as movement can be expected. A 27 inch deep perimeter footing should be placed around the perimeter of slabs that abut landscaped areas (where landscape water cannot be controlled) to impair the migration of moisture under the slab.

Drainage

Positive drainage should be established to carry pad waters away from structures and foundations, and to prevent uncontrolled or sheet flow over manufactured slopes. We recommend as steep a gradient as practical be established around the structures, to the street or other non-erosive drainage devices. Fine-grade fills placed to create pad drainage should be compacted in order to retard infiltration of surface water.

Preserving proper surface drainage is also important. Planters, decorative walls, plants, trees or accumulations of organic matter should not be allowed to retard surface drainage. Area drains and roof gutters (if present) should be kept free of obstruction. Roof gutters (if present) and/or condensation lines from air conditioners should outlet to a non-erodible device, i.e., walkways, patios, driveways, drain lines or splash blocks that direct the water away from the structure. Swales and/or area drains should outlet to the street or acceptable non-erodible device. Positive drainage along the backs of retaining walls should be maintained. Any other measures that will facilitate positive surface drainage should be employed.

Utility Trench Backfill

Backfill for utility trench excavations should be compacted to the appropriate relative compaction. Where installed in sloping areas, the backfill should be properly keyed and benched.

CLOSURE

This geotechnical report has been prepared in accordance with generally accepted engineering practices at this time and location. No other warranties, either express or implied, are made as to the professional advice provided under the terms of our agreement and included in this report.

Thank you for this opportunity to be of service. Please do not hesitate to call if you have any questions regarding this report.

Respectfully submitted,
GEOLABS-WESTLAKE VILLAGE

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LKS:af

XC: (3) Addressee
(2) City of Thousand Oaks c/o Addressee

REFERENCE LIST:

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..., June 22, 1999; Geotechnical Investigation, Proposed Residence Hall, West of Luther Street, California Lutheran University, Thousand Oaks Area, County of Ventura, California

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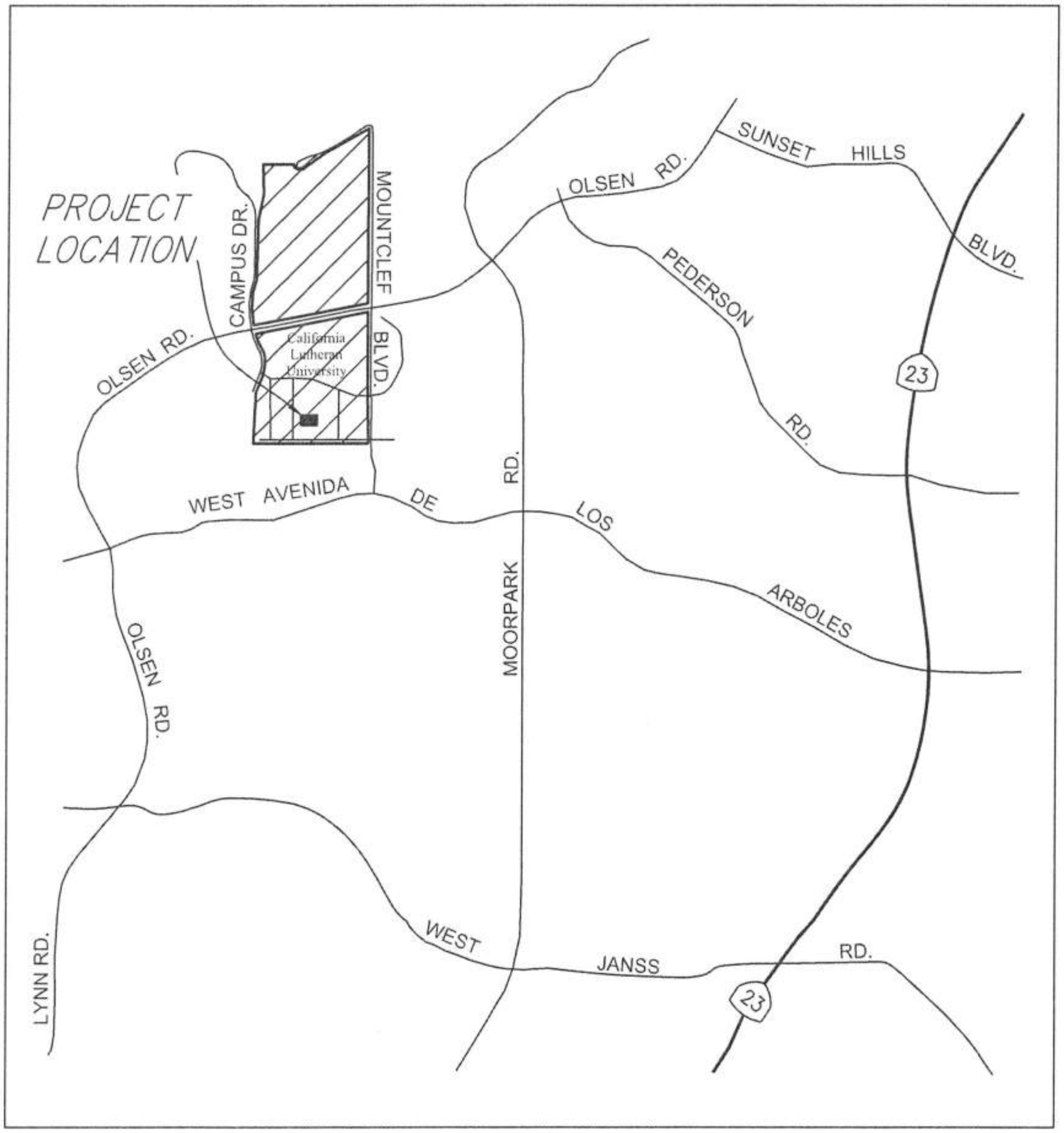
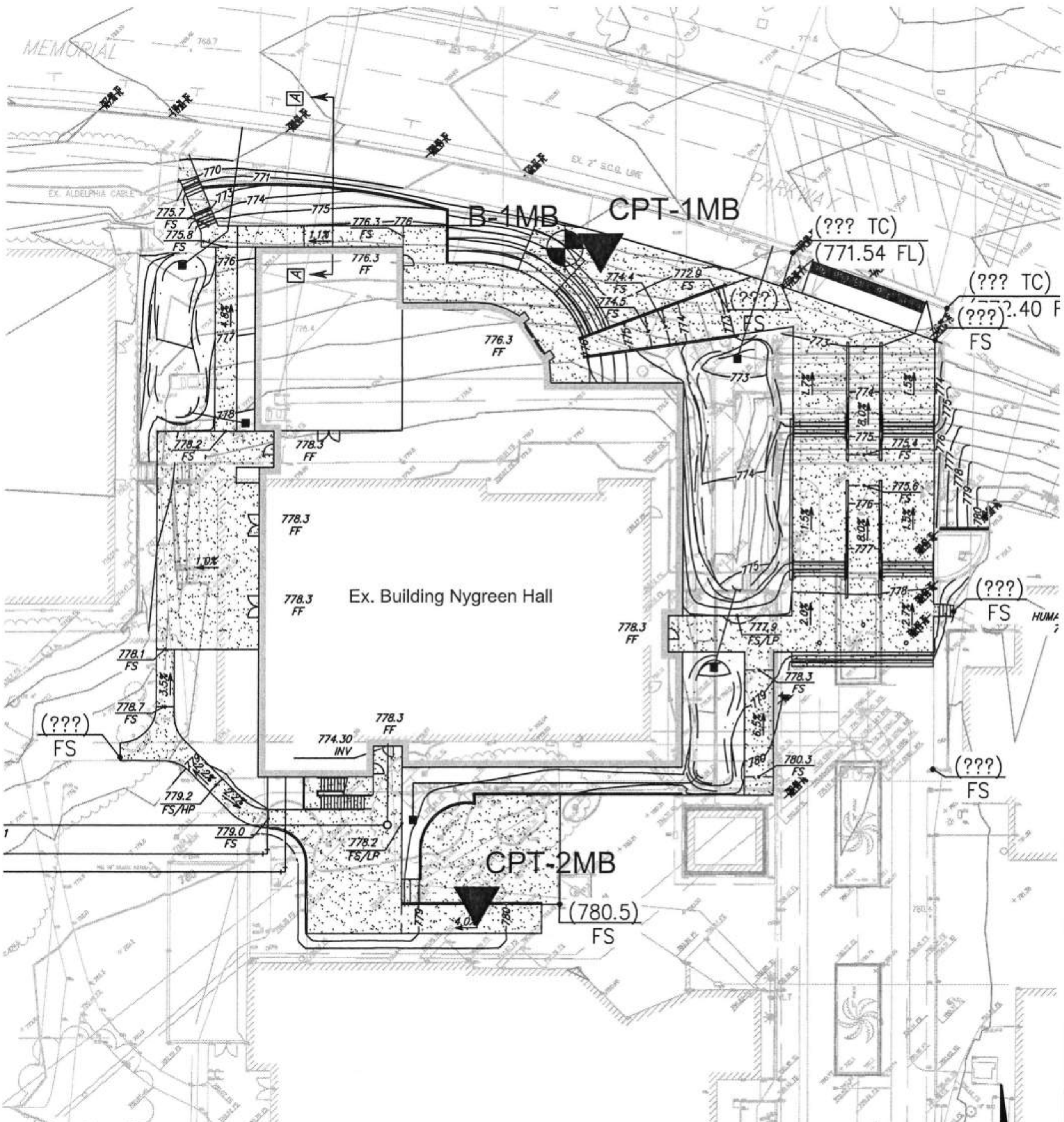
LOCATION MAP

Proposed Management Building
California Lutheran University
City of Thousand Oaks, CA



Geolabs – Westlake Village GEOLOGY AND SOIL ENGINEERING
DATE 4/22/2019 BY JN SCALE NTS W.O. 8491
PLATE 1.1

PLOT PLAN



40 20 10 0 40

1"=40'

EXPLANATION

B-1

Approximate Location of Boring

CPT-2

Approximate Location of CPT (Cone Penetrometer Testing)

Geolabs - Westlake Village

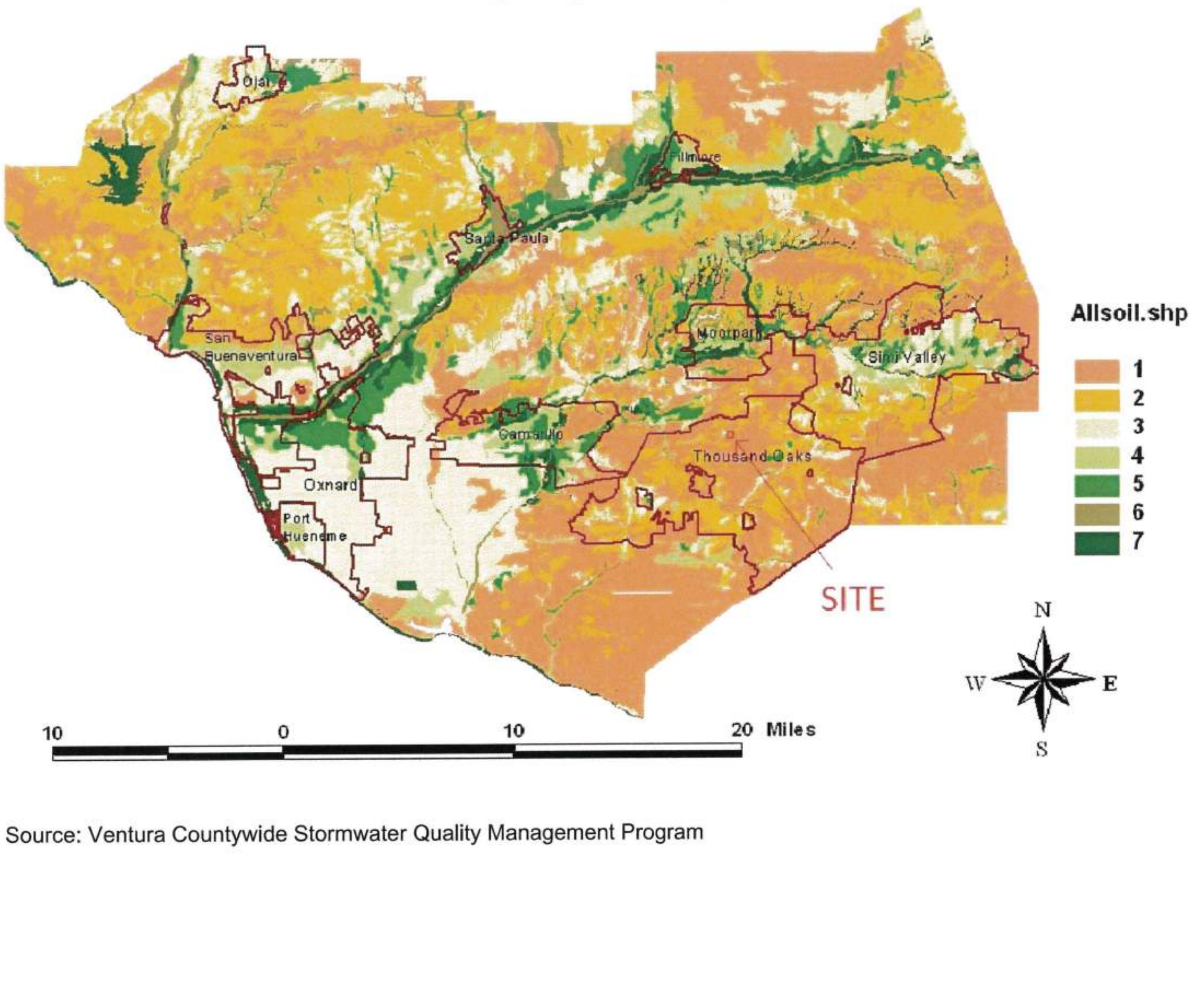
GEOLOGY AND SOIL ENGINEERING

DATE 4/22/2019 BY JN

SCALE 1"~40' W.O. 8491

PLATE 1.2

Ventura County Hydrologic Soils Map



Source: Ventura Countywide Stormwater Quality Management Program

P:\8491 CLCM\8491 Science Bldg\VCHydroSoils Map.dwg\Plate 1.3_2015.09

Geolabs – Westlake Village
GEOLOGY AND SOIL ENGINEERING

DATE 9/1/2015 BY JN
SCALE NTS W.O. 8491

PLATE 1.3

Appendix A
Subsurface Exploration

W.O. 8491
April 29, 2019

SUBSURFACE DATA BORING LOG: B1.MB

CLIENT: CLU	PROJECT: Management Building	WO: 8491.027
LOCATION: Thousand Oaks	ELEVATION: ±772	DATE: 3/26/2019
RIG TYPE: Bucket/LAR/Rot.Wash	HAMMER WEIGHTS: 140 lb. Auto Hammer	GEOLOGIST: JN

	N	U	B	M	DD	DESCRIPTION	COMMENTS
0						@0' - Grass over dark brown CLAY (CL), moist.	Hand auger to 2'
						@1' - Light yellowish brown fine sandy SILT (ML) with trace clay, moist,	
2.5	10/20/27	C	X	25.9	102.5	slighly plastic.	Bulk 2.5'-5'
						@2.5' - Light grayish brown SILT (ML) and lean CLAY (CL), moist with very	
						stiff, fine gravel sized carbonate nodules, slightly plastic, trace root hairs.	
5	27/29/34	C		19.0	107.4	@5' - Light gray and light yellowish brown SILT (ML) with fine gravel sized	
						carbonates, hard, moist, rootlets.	
7.5	12/17/22	C		19.0	107.9	@7.5' - Light brown silty fine SAND(SM) over very fine sandy SILT (ML)	
						with trace clay, medium dense, moist, slight to non-plastic.	
10	9/11/11		S	34.0		@10' - Light brown fine to medium SAND (SM) over, light gray lean	
						CLAY (CL) with fine sand, very stiff, moist, slightly plastic.	
12.5	5/9/10		S	30.4		@12.5' - Light gray lean CLAY (CL) and SILT (ML), very stiff, moist.	
15	15/22/29	C		34.0	86.7	@15' - Light gray very fine sandy SILT (ML/SM) with clay over a lean	
						CLAY (CL) with trace sand, poorly graded, hard, moist, slightly plastic.	
20	5/6/9		S	34.1		@20' - Light gray and white very fine sandy SILT (ML) with clay, over	
						(@21.5') light grayish white fat CLAY (CH), stiff, moist, slightly plastic,	
						trace rootlets.	
25	5/7/8		S	39.3		@25' - Light gray lean CLAY (CL) with trace scattered sand, stiff, moist,	
						very wet on bottom of sampler.	
30	23/29/44	C		25.3	98.9	@30' - Light gray and light gray brown SILT (ML) with fine sand, over	
						light gray fat CLAY (CH), hard, moist, slightly plastic.	
35	7/7/11		S	32.6		@35' - Light grayish brown lean CLAY (CL) with fine sand and few coarse	@35' drilling
						scattered sand, very stiff, light gray to white carbonates throughtout.	slowed
40	10/20/40		S	26.1		@40' - Reddish brown silty SAND (SM) with scattered coarse sand, poorly	
						graded, very dense, moist, carbonate stringers.	
45	15/22/28		S	33.9		@45' - Light reddish brown sandy lean CLAY (CL), with coarse scattered	
						sand, hard, moist, carbonate stringers, slight to non-plastic.	
49	39/50-4"	C		27.4	95.5	@49' - Light grayish brown sandy SILT (ML) with clay and few coarse	@49' auger
50						scattered sand, very dense, moist, carbonate stringers.	not advancing

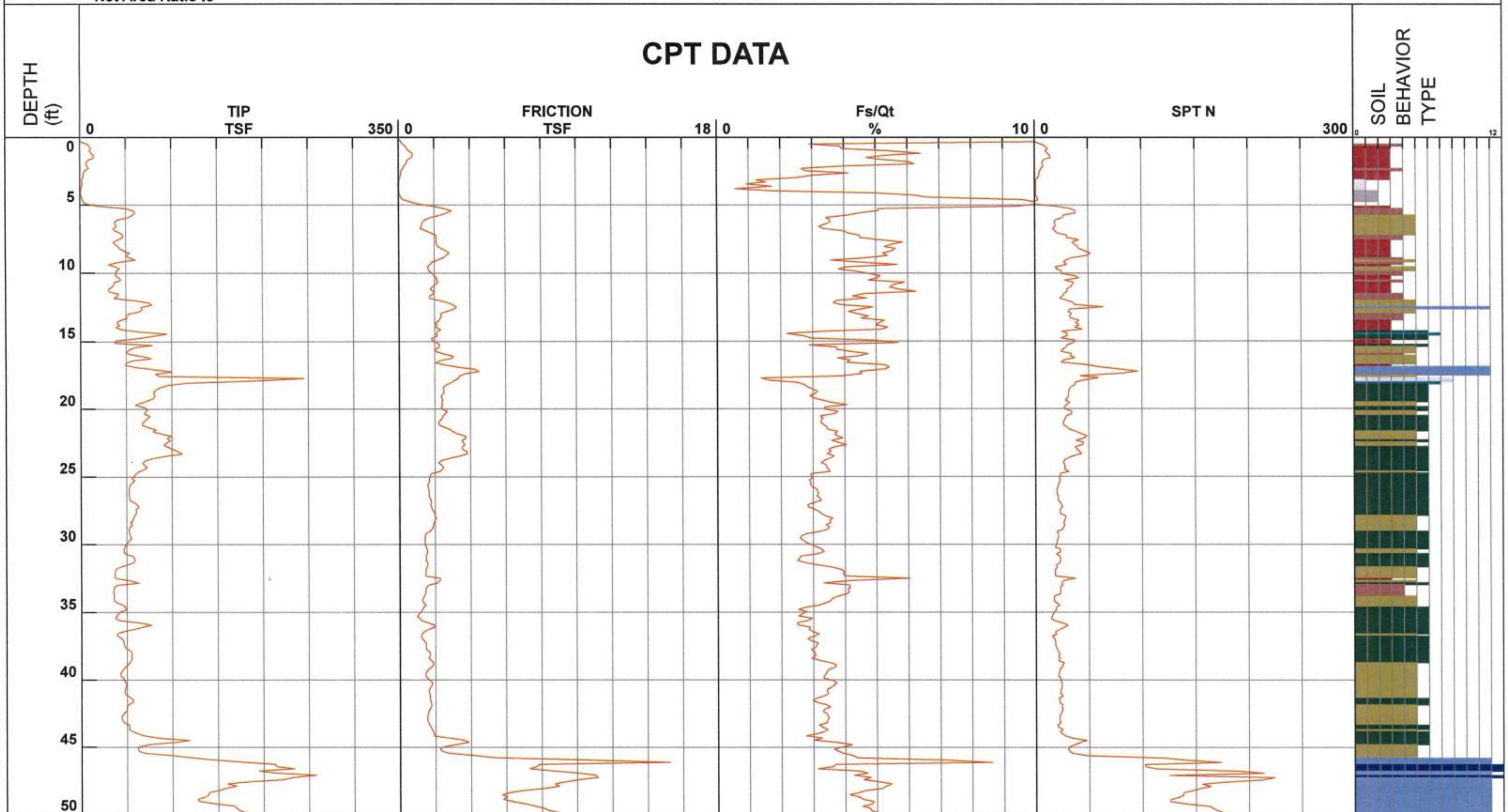
ADDITIONAL COMMENTS:	TOTAL DEPTH : 49'	U = Undisturbed Sample	N = Field Blowcount
	GROUNDWATER: ±18' (elev. ±754)	X = Disturbed Bulk Sample	B = Disturbed Sample
	CAVING: No	C = Modified California Sample	M = Moisture %
		S= Standard Penetration Test Blows per 6"	DD = Dry Density (pcf)

Geolabs WV

Project	CLU-New Management Building	Operator	BH-ADS	Filename	SDF(520).cpt
Job Number	8491.027	Cone Number	DDG1471	GPS	
Hole Number	CPT-02	Date and Time	3/28/2019 4:41:12 PM	Maximum Depth	51.02 ft
EST GW Depth During Test		18.00 ft			

Net Area Ratio .8

CPT DATA



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

CLU-New Management Building

Project ID: Geolabs WV
Data File: SDF(520).cpt
CPT Date: 3/28/2019 4:41:12 PM
GW During Test: 18 ft

Sounding ID: CPT-02
Project No: 8491.027
Cone/Rig: DDG1471

Depth ft	qc PS tsf	* qc1n PS -	q1ncs PS -	* qt PS tsf	Slv Stss tsf	pore prss (psi)	Frct Rato %	* Mat Typ Zon	* Material Behavior Description	Unit Wght pcf	Qc to N	* SPT R-N1 60%	SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	Und Shr tsf	OCR - -	* Fin Ic %	* D50 - mm	* Ic SBT Indx	* Nk - -
0.33	1.3	2.1	-	1.3	0.2	0.1	9.9	2	Organic SOILS - Peats	100	1.0	2	1	1	-	-	0.1	9.9	95	0.100	3.86	10
0.49	8.7	14.0	-	8.7	0.3	0.4	2.9	3	silty CLAY to CLAY	115	1.5	9	6	4	-	-	0.6	9.9	50	0.005	2.87	15
0.66	10.2	16.3	-	10.2	0.4	0.7	3.9	3	silty CLAY to CLAY	115	1.5	11	7	5	-	-	0.7	9.9	52	0.005	2.90	15
0.82	12.2	19.6	-	12.2	0.5	0.8	3.9	3	silty CLAY to CLAY	115	1.5	13	8	6	-	-	0.9	9.9	48	0.005	2.84	15
0.98	10.6	17.0	-	10.6	0.6	0.8	5.4	3	silty CLAY to CLAY	115	1.5	11	7	5	-	-	0.7	9.9	57	0.005	2.98	15
1.15	12.4	19.8	-	12.4	0.8	0.6	6.5	3	silty CLAY to CLAY	115	1.5	13	8	6	-	-	0.9	9.9	57	0.005	2.97	15
1.31	15.0	24.0	-	15.0	0.8	0.8	5.3	3	silty CLAY to CLAY	115	1.5	16	10	7	-	-	1.1	9.9	49	0.005	2.86	15
1.48	15.3	24.5	-	15.3	0.7	0.8	4.7	3	silty CLAY to CLAY	115	1.5	16	10	7	-	-	1.1	9.9	47	0.005	2.82	15
1.64	9.7	15.5	-	9.7	0.5	0.8	5.3	3	silty CLAY to CLAY	115	1.5	10	6	5	-	-	0.7	9.9	58	0.005	3.00	15
1.80	7.2	11.5	-	7.2	0.4	0.6	6.1	3	silty CLAY to CLAY	115	1.5	8	5	4	-	-	0.5	9.9	69	0.005	3.14	15
1.97	6.8	11.0	-	6.9	0.4	0.5	6.3	3	silty CLAY to CLAY	115	1.5	7	5	4	-	-	0.5	9.9	70	0.005	3.17	15
2.13	7.9	12.7	-	7.9	0.3	0.5	4.1	3	silty CLAY to CLAY	115	1.5	8	5	4	-	-	0.6	9.9	58	0.005	3.00	15
2.30	9.6	15.3	-	9.6	0.3	0.6	2.7	4	clayy SILT to silty CLAY	115	2.0	8	5	4	-	-	0.7	9.9	47	0.070	2.82	15
2.46	5.6	9.0	-	5.6	0.2	0.2	2.9	3	silty CLAY to CLAY	115	1.5	6	4	3	-	-	0.4	9.9	61	0.005	3.03	15
2.62	3.7	6.0	-	3.7	0.2	0.4	4.3	3	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.3	7.9	80	0.005	3.29	15
2.79	3.8	6.1	-	3.8	0.1	0.3	3.1	3	silty CLAY to CLAY	115	1.5	4	3	2	-	-	0.3	7.6	73	0.005	3.20	15
2.95	3.3	5.3	-	3.3	0.1	0.4	2.6	3	silty CLAY to CLAY	115	1.5	4	2	2	-	-	0.2	6.1	75	0.005	3.22	15
3.12	2.2	3.5	-	2.2	0.0	0.3	1.3	3	silty CLAY to CLAY	115	1.5	2	1	1	-	-	0.1	3.7	78	0.005	3.26	15
3.28	2.3	3.7	-	2.3	0.0	0.2	1.7	3	silty CLAY to CLAY	115	1.5	2	2	1	-	-	0.2	3.8	79	0.005	3.27	15
3.45	2.5	4.0	-	2.5	0.0	0.1	1.0	3	silty CLAY to CLAY	115	1.5	3	2	1	-	-	0.2	3.9	69	0.005	3.15	15
3.61	1.9	3.0	-	1.9	0.0	0.1	1.9	3	silty CLAY to CLAY	115	1.5	2	1	1	-	-	0.1	2.7	89	0.005	3.39	15
3.77	1.6	2.5	-	1.6	0.0	0.2	0.7	1	sensitive fine SOIL	115	2.0	1	1	1	-	-	0.1	2.1	81	0.005	3.30	15
3.94	1.2	1.9	-	1.2	0.0	0.1	2.2	3	silty CLAY to CLAY	115	1.5	1	1	1	-	-	0.1	1.4	95	0.005	3.63	15
4.10	1.1	1.0	-	1.1	0.0	0.2	7.9	2	Organic SOILS - Peats	100	1.0	1	1	1	-	-	0.1	1.2	95	0.100	4.24	10
4.27	1.2	1.9	-	1.2	0.1	0.0	7.8	2	Organic SOILS - Peats	100	1.0	2	1	1	-	-	0.1	1.3	95	0.100	3.91	10
4.43	1.9	3.0	-	1.9	0.1	0.0	7.7	2	Organic SOILS - Peats	100	1.0	3	2	2	-	-	0.2	2.1	95	0.100	3.71	10
4.59	2.7	4.4	-	2.7	0.3	0.1	9.9	2	Organic SOILS - Peats	100	1.0	4	3	2	-	-	0.3	3.2	95	0.100	3.63	10
4.76	3.6	5.8	-	3.6	0.7	0.2	9.9	2	Organic SOILS - Peats	100	1.0	6	4	3	-	-	0.4	4.1	95	0.100	3.53	10
4.92	7.5	12.0	-	7.5	1.2	0.4	9.9	3	silty CLAY to CLAY	115	1.5	8	5	5	-	-	0.5	8.7	79	0.005	3.27	15
5.09	20.8	33.3	-	20.8	2.0	1.6	9.6	3	silty CLAY to CLAY	115	1.5	22	14	10	-	-	1.4	9.9	55	0.005	2.94	15
5.25	51.2	82.1	218.6	51.3	2.6	3.9	5.1	9	very stiff fine SOIL	120	1.0	82	51	20	-	-	1.8	9.9	30	0.250	2.48	30
5.41	58.8	94.4	234.9	58.9	3.0	4.9	5.1	9	very stiff fine SOIL	120	1.0	94	59	22	-	-	2.1	9.9	28	0.250	2.44	30
5.58	60.1	96.4	220.3	60.3	2.7	7.3	4.5	9	very stiff fine SOIL	120	1.0	96	60	22	-	-	2.1	9.9	26	0.250	2.39	30
5.74	57.3	91.9	204.4	57.5	2.4	7.5	4.1	4	clayy SILT to silty CLAY	115	2.0	46	29	21	-	-	4.0	9.9	26	0.070	2.38	15
5.91	53.3	85.5	177.4	53.5	1.8	9.2	3.5	5	silty SAND to sandy SILT	120	3.0	28	18	19	62	43	-	-	24	0.200	2.34	16
6.07	42.3	67.8	161.5	42.4	1.5	8.0	3.6	4	clayy SILT to silty CLAY	115	2.0	34	21	16	-	-	3.0	9.9	27	0.070	2.42	15
6.23	38.0	61.0	154.3	38.2	1.4	8.3	3.6	4	clayy SILT to silty CLAY	115	2.0	30	19	14	-	-	2.7	9.9	29	0.070	2.45	15
6.40	38.6	61.9	151.6	38.7	1.3	8.4	3.4	4	clayy SILT to silty CLAY	115	2.0	31	19	15	-	-	2.7	9.9	28	0.070	2.43	15
6.56	39.7	63.4	148.3	39.9	1.3	8.8	3.2	4	clayy SILT to silty CLAY	115	2.0	32	20	15	-	-	2.8	9.9	27	0.070	2.41	15
6.73	36.3	57.2	144.8	36.5	1.2	9.1	3.4	4	clayy SILT to silty CLAY	115	2.0	29	18	14	-	-	2.5	9.9	29	0.070	2.45	15
6.89	39.0	60.7	164.4	39.2	1.6	10.2	4.0	4	clayy SILT to silty CLAY	115	2.0	30	19	15	-	-	2.7	9.9	30	0.070	2.49	15
7.05	44.2	68.0	176.7	44.4	1.8	11.1	4.2	4	clayy SILT to silty CLAY	115	2.0	34	22	16	-	-	3.1	9.9	29	0.070	2.47	15
7.22	46.7	71.0	189.5	46.9	2.1	10.2	4.5	4	clayy SILT to silty CLAY	115	2.0	36	23	17	-	-	3.3	9.9	30	0.070	2.48	15
7.38	47.1	70.8	189.5	47.3	2.1	10.0	4.5	4	clayy SILT to silty CLAY	115	2.0	35	24	17	-	-	3.3	9.9	30	0.070	2.48	15
7.55	42.2	62.7	192.1	42.4	2.1	7.9	5.1	4	clayy SILT to silty CLAY	115	2.0	31	21	16	-	-	3.0	9.9	33	0.070	2.55	15
7.71	36.2	58.1	-	36.3	2.1	5.0	5.9	3	silty CLAY to CLAY	115	1.5	39	24	15	-	-	2.5	9.9	37	0.005	2.63	15
7.87	38.5	61.8	201.4	38.6	2.1	4.6	5.6	4	clayy SILT to silty CLAY	115	2.0	31	19	16	-	-	2.7	9.9	35	0.070	2.59	15
8.04	41.9	60.3	193.5	42.0	2.2	6.4	5.3	4	clayy SILT to silty CLAY	115	2.0	30	21	15	-	-	2.9	9.9	34	0.070	2.58	15
8.20	43.2	61.6	203.3	43.4	2.4	8.1	5.7	4	clayy SILT to silty CLAY	115	2.0	31	22	16	-	-	3.0	9.9	35	0.070	2.60	15
8.37	48.6	68.5	211.1	48.8	2.7	10.0	5.6	4	clayy SILT to silty CLAY	115	2.0	34	24	17	-	-	3.4	9.9	33	0.070	2.56	15
8.53	54.6	76.3	215.1	54.8	2.8	11.4	5.3	4	clayy SILT to silty CLAY	115	2.0	38	27	19	-	-	3.8	9.9	31	0.070	2.51	15
8.69	49.9	69.0	208.7	50.1	2.7	10.1	5.4	4	clayy SILT to silty CLAY	115	2.0	35	25	17	-	-	3.5	9.9	33	0.070	2.55	15
8.86	53.8	73.8	197.4	54.0	2.5	7.7	4.7	4	clayy SILT to silty CLAY	115	2.0	37	27	18	-	-	3.8	9.9	30	0.070	2.48	15
9.02	60.6	82.3	178.5	60.8	2.2	5.7	3.6	4	clayy SILT to silty CLAY	115	2.0	41	30	19	-	-	4.2	9.9	25	0.070	2.36	15
9.19	41.8	56.3	169.5	41.9	1.9	4.7	4.5	4	clayy SILT to silty CLAY	115	2.0	28	21	14	-	-	2.9	9.9	33	0.070	2.55	15
9.35	31.0	49.7	-	31.1	1.8	5.0	5.8	3	silty CLAY to CLAY	115	1.5	33	21	13	-	-	2.2	9.9	39	0.005	2.66	15
9.51	39.7	52.5	156.4	39.8	1.6	2.7	4.1	4	clayy SILT to silty CLAY	115	2.0	26	20	13	-	-	2.8	9.9	32	0.070	2.54	15
9.68	43.3	56.7	156.0	43.3	1.7	0.1	3.9	4	clayy SILT to silty CLAY	115	2.0	28	22	14	-	-	3.0	9.9	31	0.070	2.50	15
9.84	39.5	51.3	161.6	39.5	1.7	3.1	4.4	4	clayy SILT to silty CLAY	115	2.0	26	20	13	-	-	2.8	9.9	34	0.070	2.57	15
10.01	39.4	57.5	179.7	39.5	1.9	3.1	4.9	4	clayy SILT to silty CLAY	115	2.0	29	20	14	-	-	2.7	9.9	34	0.070	2.57	15
10.17	39.1	56.3	185.5	39.1	2.0	2.9	5.2	4	clayy SILT to silty CLAY	115	2.0	28	20	14	-	-	2.7	9.9	35	0.070	2.59	15
10.34	43.0	54.5	179.9	43.1	2.2	3.7	5.1	4	clayy SILT to silty CLAY	115	2.0	27	21	14	-	-	3.0	9.9	35	0.070	2.60	15
10.50	44.3	55.7	176.0	44.4	2.1	4.1	4.8	4	clayy SILT to silty CLAY	115	2.0	28	22	14	-	-	3.1	9.9	34	0.070	2.57	15
10.66	37.6	60.4	-	37.7	2.2	3.2	6.0	3	silty CLAY to CLAY	115	1.5	40	25	16	-	-	2.6	9.9	36	0.005	2.62	15
10.83	36.6	58.7	-	36.7	2.0	3.3	5.6	4	clayy SILT to silty CLAY	115	2.0	29	18	15	-	-	2.5	9.9	36	0.070	2.61	15
10.99	34.8	55.7	-	34.9	1.9	1.7	5.5	4	clayy SILT to silty CLAY	115	2.0	28	17	14	-	-	2.4	9.9	36	0.070	2.62	15
11.16	30.9	48.7	-	30.9	1.8	1.9	5.9	3	silty CLAY to CLAY	115	1.5	32	21	13	-	-	2.1	9.9	39	0.005	2.68	15
11.32	31.5	48.9	-	31.5	2.0	2.1	6.4	3	silty CLAY to CLAY	115	1.5	33	21	13	-	-	2.2	9.9	41	0.005	2.70	15
11.48	42.2	50.7	165.7	42.2	1.9	2.2	4.7	4	clayy SILT to silty CLAY	115	2.0	25	21	13	-	-	2.9	9.9	35	0.070	2.59	15
11.65	40.4	48.2	155.2	40.5	1.7	1.9	4.3	4	clayy SILT to silty CLAY	115	2.0	24	20	12	-	-	2.8	9.9	34	0.070	2.58	15
11.81	36.7	47.6	-	36.7	1.7	3.4	4.8	4	clayy SILT to silty CLAY	115	2.0	24	18	12	-	-	2.5	9.9	36	0.070	2.62	15
11.98	61.8	72.8	173.3	61.9	2.3	2.1	3.8	4	clayy SILT to silty CLAY	115	2.0	36	31	17	-	-	4.3	9.9	27	0.070	2.42	15
12.14	75.2	87.9	187.0	75.3	2.7	2.0	3.7	4	clayy SILT to silty CLAY	115	2.0	44	38	20	-	-	5.3	9.9	24	0.070	2.35	15
12.30	78.2	90.8	197.0	78.3	3.0	3.6	3.9	4	clayy SILT to silty CLAY	115	2.0	45	39	21	-	-	5.5	9.9	25	0.070	2.36	15
12.47	66.7	76.9	208.3	66.8	3.3	6.2	5.0	4	clayy SILT to silty CLAY	115	2.0	38	33	19	-	-	4.7	9.9	30	0.070	2.49	15
12.63	67.7	77.5	198.1	67.8	3.0	7.0	4.5	4	clayy SILT to silty CLAY	115	2.0	39	34	18	-	-	4.7	9.9	29	0.070	2.46	15
12.80	64.5	73.4	183.9	64.6	2.7	5.6	4.2	4	clayy SILT to silty CLAY	115	2.0	37	32	17	-	-	4.5	9.9	28	0.070	2.45	15
12.96	53.5	60.5	174.4	53.6	2.3	6.4	4.4	4	clayy SILT to silty CLAY	115	2.0	30	27	15	-	-	3.7	9.9	32	0.070	2.52	15
13.12	50.2	56.4	177.2	50.3	2.4	6.6	4.8	4	clayy SILT to silty CLAY	115	2.0	28	25	14	-	-	3.5	9.9	34	0.070	2.57	15
13.29	51.5	57.4	173.6	51.6	2.3	5.8	4.6	4	clayy SILT to silty CLAY	115	2.0	29	26	14	-	-	3.6	9.9	33	0.070	2.55	15
13.45	42.7	55.8	-	42.8	2.3	4.9	5.4	4	clayy SILT to silty CLAY	115	2.0	28	21	14	-	-	3.0	9.9	36	0.070	2.61	15
13.62	40.0	51.5	-	40.1	2.0	5.0	5.2	4	clayy SILT to silty CLAY	115	2.0	26	20	13	-	-	2.8	9.9	36	0.070	2.62	15
13.78	43.0	50.0	-	43.1	2.1	5.7	5.1	4	clayy SILT to silty CLAY	115	2.0	25	21	13	-	-	3.0	9.9	36	0.070	2.62	15
13.94	38.6	48.6	-	38.7	2.1	6.1	5.5	3	silty CLAY to CLAY	115	1.5	32	26	13	-	-	2.7	9.9	38	0.005	2.65	15
14.11	45.3	51.9	-	45.4	2.3	5.3	5.2	4	clayy SILT to silty CLAY	115	2.0	26	23	13	-	-	3.1	9.9	36	0.070	2.62	15
14.27	65.4	70.4	158.9	65.5	2.2	5.8	3.3	4	clayy SILT to silty CLAY	115	2.0	35	33	16	-	-	4.6	9.9	26	0.070	2.39	15
14.44	95.2	101.9	156.7	95.3	2.1	4.6	2.2	5	silty SAND to sandy SILT	120	3.0	34	32	21	68	41	-	-	17	0.200	2.14	16
14.60	79.1	84.2	156.6	79.2	2.2	3.0	2.8	5	silty SAND to sandy SILT	120	3.0	28	26	18	61	40	-	-	21	0.200	2.27	16
14.76	61.5	65.1	144.2	61.6	1.8	2.6	3.0	5	silty SAND to sandy SILT	120	3.0	22	20	15	53	39	-	-	25	0.200	2.38	16
14.93	38.7	45.4	-	38.8	1.9	3.5	5.0	4	clayy SILT to silty CLAY	115	2.0	23	19	12	-	-	2.7	9.9	38	0.070	2.65	15
15.09	37.6	43.6	-	37.7	2.1	5.0	5.8	3	silty CLAY to CLAY	115	1.5	29	25	12	-	-	2.6	9.9	41	0.005	2.71	15
15.26	79.2	82.4	159.5	79.3	2.3	4.9	2.9	5	silty SAND to sandy SILT	120	3.0	27	26	18	61	40	-	-	22	0.200	2.30	16
15.42	59.7	61.8	160.8	59.8	2.2	4.2	3.8	4	clayy SILT to silty CLAY	115	2.0	31	30	15	-	-	4.2	9.9	29	0.070	2.47	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

CLU-New Management Building

Project ID: Geolabs WV
Data File: SDF(520).cpt
CPT Date: 3/28/2019 4:41:12 PM
GW During Test: 18 ft

Sounding ID: CPT-02
Project No: 8491.027
Cone/Rig: DDG1471

Depth ft	qc PS tsf	* qc1n PS -	qc1ncs PS -	* qt PS tsf	Slv Stss tsf	pore prss (psi)	Frct Rato %	* Mat Typ Zon	* Material Behavior Description	Unit Wght pcf	Qc to N	* SPT R-N1 60%	SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	Und Shr tsf	OCR -	* Fin Ic %	* D50 - mm	* Ic SBT Indx	* Nk -
15.58	53.7	55.2	153.3	53.9	2.0	9.8	3.8	4	clayy SILT to silty CLAY	115	2.0	28	27	13	-	-	3.7	9.9	31	0.070	2.50	15
15.75	50.7	51.9	159.1	50.9	2.1	10.3	4.3	4	clayy SILT to silty CLAY	115	2.0	26	25	13	-	-	3.5	9.9	33	0.070	2.56	15
15.91	53.3	54.3	174.3	53.5	2.5	10.8	4.8	4	clayy SILT to silty CLAY	115	2.0	27	27	14	-	-	3.7	9.9	34	0.070	2.58	15
16.08	69.3	70.2	188.2	69.6	3.1	12.4	4.5	4	clayy SILT to silty CLAY	115	2.0	35	35	17	-	-	4.8	9.9	30	0.070	2.48	15
16.24	77.7	78.3	180.3	77.9	2.9	11.0	3.8	4	clayy SILT to silty CLAY	115	2.0	39	39	18	-	-	5.4	9.9	26	0.070	2.40	15
16.40	56.1	56.3	164.5	56.3	2.3	10.4	4.2	4	clayy SILT to silty CLAY	115	2.0	28	28	14	-	-	3.9	9.9	32	0.070	2.53	15
16.57	50.2	50.1	154.3	50.5	2.0	13.7	4.2	4	clayy SILT to silty CLAY	115	2.0	25	25	13	-	-	3.5	9.9	33	0.070	2.56	15
16.73	49.3	51.5	-	49.6	2.6	14.9	5.4	4	clayy SILT to silty CLAY	115	2.0	26	25	13	-	-	3.4	9.9	37	0.070	2.63	15
16.90	61.3	60.5	198.0	61.6	3.3	15.7	5.5	4	clayy SILT to silty CLAY	115	2.0	30	31	15	-	-	4.3	9.9	35	0.070	2.59	15
17.06	80.5	79.1	221.5	80.7	4.2	13.3	5.3	9	very stiff fine SOIL	120	1.0	79	80	19	-	-	2.8	9.9	31	0.250	2.51	30
17.23	100.5	98.4	223.3	100.8	4.5	13.7	4.5	9	very stiff fine SOIL	120	1.0	98	100	23	-	-	3.5	9.9	26	0.250	2.39	30
17.39	82.0	79.8	203.1	82.2	3.7	9.8	4.6	4	clayy SILT to silty CLAY	115	2.0	40	41	19	-	-	5.7	9.9	29	0.070	2.45	15
17.55	86.7	84.0	190.0	87.1	3.4	18.2	3.9	4	clayy SILT to silty CLAY	115	2.0	42	43	19	-	-	6.1	9.9	26	0.070	2.39	15
17.72	245.1	236.4	252.6	245.6	3.3	25.3	1.4	6	clean SAND to silty SAND	125	5.0	47	49	42	95	45	-	-	7	0.350	1.75	16
17.88	189.7	182.0	212.9	189.9	3.1	10.0	1.6	6	clean SAND to silty SAND	125	5.0	36	38	34	87	44	-	-	10	0.350	1.88	16
18.05	117.3	112.3	176.7	117.5	2.9	10.8	2.5	5	silty SAND to sandy SILT	120	3.0	37	39	23	71	41	-	-	18	0.200	2.16	16
18.21	96.2	91.9	164.7	96.4	2.6	9.8	2.8	5	silty SAND to sandy SILT	120	3.0	31	32	20	64	40	-	-	21	0.200	2.25	16
18.37	86.8	82.7	158.9	87.1	2.5	12.5	2.9	5	silty SAND to sandy SILT	120	3.0	28	29	18	61	40	-	-	22	0.200	2.29	16
18.54	82.9	78.8	159.5	83.1	2.5	10.4	3.0	5	silty SAND to sandy SILT	120	3.0	26	28	18	59	39	-	-	23	0.200	2.32	16
18.70	80.0	75.9	160.6	80.2	2.5	9.0	3.2	5	silty SAND to sandy SILT	120	3.0	25	27	17	58	39	-	-	24	0.200	2.35	16
18.87	80.8	76.5	158.8	81.0	2.5	8.1	3.1	5	silty SAND to sandy SILT	120	3.0	25	27	17	58	39	-	-	24	0.200	2.34	16
19.03	81.5	77.0	155.0	81.7	2.4	9.5	2.9	5	silty SAND to sandy SILT	120	3.0	26	27	17	58	39	-	-	23	0.200	2.32	16
19.19	79.4	74.8	156.4	79.5	2.4	9.1	3.1	5	silty SAND to sandy SILT	120	3.0	25	26	17	57	39	-	-	24	0.200	2.34	16
19.36	74.0	69.6	158.5	74.2	2.4	7.3	3.4	4	clayy SILT to silty CLAY	115	2.0	35	37	16	-	-	5.2	9.9	26	0.070	2.39	15
19.52	67.3	63.1	158.5	67.4	2.4	6.8	3.6	4	clayy SILT to silty CLAY	115	2.0	32	34	15	-	-	4.7	9.9	28	0.070	2.45	15
19.69	59.8	56.0	162.2	59.9	2.4	6.5	4.2	4	clayy SILT to silty CLAY	115	2.0	28	30	14	-	-	4.1	9.9	32	0.070	2.52	15
19.85	70.2	65.6	155.9	70.4	2.4	6.6	3.4	4	clayy SILT to silty CLAY	115	2.0	33	35	15	-	-	4.9	9.9	27	0.070	2.42	15
20.01	73.3	68.3	159.1	73.4	2.5	6.5	3.4	4	clayy SILT to silty CLAY	115	2.0	34	37	16	-	-	5.1	9.9	27	0.070	2.40	15
20.18	71.4	66.5	167.6	71.6	2.7	8.1	3.8	4	clayy SILT to silty CLAY	115	2.0	33	36	16	-	-	5.0	9.9	28	0.070	2.45	15
20.34	70.1	65.1	163.1	70.4	2.6	18.0	3.7	4	clayy SILT to silty CLAY	115	2.0	33	35	15	-	-	4.9	9.9	28	0.070	2.45	15
20.51	76.1	70.5	157.5	76.4	2.5	18.5	3.3	4	clayy SILT to silty CLAY	115	2.0	35	38	16	-	-	5.3	9.9	26	0.070	2.38	15
20.67	73.1	67.7	156.8	73.5	2.4	18.2	3.4	4	clayy SILT to silty CLAY	115	2.0	34	37	16	-	-	5.1	9.9	26	0.070	2.40	15
20.83	70.8	65.4	152.9	71.2	2.3	20.5	3.3	4	clayy SILT to silty CLAY	115	2.0	33	35	15	-	-	4.9	9.9	27	0.070	2.41	15
21.00	67.9	62.6	149.8	68.4	2.2	23.1	3.3	4	clayy SILT to silty CLAY	115	2.0	31	34	15	-	-	4.7	9.9	27	0.070	2.42	15
21.16	67.4	62.0	151.8	67.9	2.3	26.2	3.4	4	clayy SILT to silty CLAY	115	2.0	31	34	15	-	-	4.7	9.9	28	0.070	2.43	15
21.33	74.1	68.0	160.3	74.6	2.5	26.5	3.5	4	clayy SILT to silty CLAY	115	2.0	34	37	16	-	-	5.2	9.9	27	0.070	2.41	15
21.49	82.8	75.8	169.5	83.4	2.9	34.3	3.5	4	clayy SILT to silty CLAY	115	2.0	38	41	17	-	-	5.8	9.9	26	0.070	2.38	15
21.65	79.5	72.8	174.6	80.1	3.0	28.8	3.8	4	clayy SILT to silty CLAY	115	2.0	36	40	17	-	-	5.5	9.9	27	0.070	2.42	15
21.82	89.4	81.6	181.9	90.1	3.3	36.7	3.7	4	clayy SILT to silty CLAY	115	2.0	41	45	19	-	-	6.2	9.9	26	0.070	2.38	15
21.98	99.2	90.4	193.6	100.1	3.7	46.8	3.8	4	clayy SILT to silty CLAY	115	2.0	45	50	21	-	-	6.9	9.9	25	0.070	2.36	15
22.15	95.1	86.5	194.3	95.6	3.7	24.1	4.0	4	clayy SILT to silty CLAY	115	2.0	43	48	20	-	-	6.6	9.9	26	0.070	2.38	15
22.31	97.9	88.9	187.0	98.6	3.5	33.2	3.6	4	clayy SILT to silty CLAY	115	2.0	44	49	20	-	-	6.8	9.9	24	0.070	2.35	15
22.47	94.6	85.7	189.7	95.1	3.6	27.4	3.9	4	clayy SILT to silty CLAY	115	2.0	43	47	20	-	-	6.6	9.9	25	0.070	2.38	15
22.64	91.0	82.3	193.1	91.3	3.7	13.1	4.1	4	clayy SILT to silty CLAY	115	2.0	41	46	19	-	-	6.4	9.9	27	0.070	2.41	15
22.80	95.8	86.5	187.2	96.0	3.5	11.4	3.7	4	clayy SILT to silty CLAY	115	2.0	43	48	20	-	-	6.7	9.9	25	0.070	2.36	15
22.97	101.9	91.8	187.3	102.3	3.6	23.7	3.5	5	silty SAND to sandy SILT	120	3.0	31	34	21	64	40	-	-	24	0.200	2.33	16
23.13	106.9	96.1	194.0	108.4	3.8	74.0	3.6	5	silty SAND to sandy SILT	120	3.0	32	36	22	66	40	-	-	23	0.200	2.32	16
23.30	111.3	99.9	194.3	112.8	3.8	73.3	3.5	5	silty SAND to sandy SILT	120	3.0	33	37	22	67	40	-	-	22	0.200	2.30	16
23.46	93.5	83.7	183.7	94.7	3.4	60.1	3.7	4	clayy SILT to silty CLAY	115	2.0	42	47	19	-	-	6.5	9.9	25	0.070	2.37	15
23.62	79.2	70.8	166.9	80.5	2.8	64.0	3.6	4	clayy SILT to silty CLAY	115	2.0	35	40	17	-	-	5.5	9.9	27	0.070	2.41	15
23.79	70.8	63.2	153.9	72.1	2.4	63.3	3.4	4	clayy SILT to silty CLAY	115	2.0	32	35	15	-	-	4.9	9.9	28	0.070	2.43	15
23.95	67.9	60.5	147.9	69.0	2.2	55.3	3.3	4	clayy SILT to silty CLAY	115	2.0	30	34	14	-	-	4.7	9.9	28	0.070	2.43	15
24.12	69.3	61.6	152.8	70.4	2.4	55.2	3.5	4	clayy SILT to silty CLAY	115	2.0	31	35	15	-	-	4.8	9.9	28	0.070	2.44	15
24.28	72.3	64.2	156.5	73.5	2.5	61.0	3.5	4	clayy SILT to silty CLAY	115	2.0	32	36	15	-	-	5.0	9.9	28	0.070	2.43	15
24.44	70.3	62.2	155.4	71.4	2.4	55.9	3.5	4	clayy SILT to silty CLAY	115	2.0	31	35	15	-	-	4.9	9.9	28	0.070	2.44	15
24.61	63.4	56.0	150.1	64.0	2.2	34.7	3.6	4	clayy SILT to silty CLAY	115	2.0	28	32	14	-	-	4.4	9.9	30	0.070	2.48	15
24.77	60.6	53.5	132.8	61.5	1.8	43.8	3.0	4	clayy SILT to silty CLAY	115	2.0	27	30	13	-	-	4.2	9.9	28	0.070	2.44	15
24.94	58.5	51.5	130.7	59.3	1.7	42.4	3.0	4	clayy SILT to silty CLAY	115	2.0	26	29	12	-	-	4.0	9.9	29	0.070	2.45	15
25.10	56.3	49.5	130.1	57.1	1.7	41.0	3.1	4	clayy SILT to silty CLAY	115	2.0	25	28	12	-	-	3.9	9.9	29	0.070	2.47	15
25.26	58.8	51.7	129.6	59.4	1.7	30.5	3.0	4	clayy SILT to silty CLAY	115	2.0	26	29	12	-	-	4.1	9.9	28	0.070	2.45	15
25.43	56.5	49.5	128.5	57.1	1.7	33.3	3.0	4	clayy SILT to silty CLAY	115	2.0	25	28	12	-	-	3.9	9.9	29	0.070	2.46	15
25.59	54.1	47.4	126.2	54.8	1.6	34.0	3.0	4	clayy SILT to silty CLAY	115	2.0	24	27	11	-	-	3.7	9.9	30	0.070	2.48	15
25.76	53.5	46.7	126.8	54.1	1.6	33.8	3.1	4	clayy SILT to silty CLAY	115	2.0	23	27	11	-	-	3.7	9.9	30	0.070	2.49	15
25.92	52.8	46.0	129.1	53.4	1.6	31.8	3.2	4	clayy SILT to silty CLAY	115	2.0	23	26	11	-	-	3.6	9.9	31	0.070	2.51	15
26.08	53.0	46.1	130.0	53.6	1.7	32.2	3.2	4	clayy SILT to silty CLAY	115	2.0	23	27	11	-	-	3.7	9.9	31	0.070	2.51	15
26.25	52.6	45.7	130.2	53.2	1.7	30.4	3.3	4	clayy SILT to silty CLAY	115	2.0	23	26	11	-	-	3.6	9.9	31	0.070	2.52	15
26.41	53.2	46.1	129.6	53.8	1.7	32.1	3.2	4	clayy SILT to silty CLAY	115	2.0	23	27	11	-	-	3.7	9.9	31	0.070	2.51	15
26.58	53.4	46.2	131.3	54.0	1.7	30.7	3.3	4	clayy SILT to silty CLAY	115	2.0	23	27	11	-	-	3.7	9.9	31	0.070	2.51	15
26.74	53.9	46.5	133.3	54.4	1.8	29.8	3.4	4	clayy SILT to silty CLAY	115	2.0	23	27	11	-	-	3.7	9.9	32	0.070	2.52	15
26.90	58.6	50.6	132.9	59.2	1.8	31.3	3.1	4	clayy SILT to silty CLAY	115	2.0	25	29	12	-	-	4.1	9.9	29	0.070	2.47	15
27.07	61.8	53.3	130.2	62.5	1.7	32.6	2.9	4	clayy SILT to silty CLAY	115	2.0	27	31	13	-	-	4.3	9.9	28	0.070	2.43	15
27.23	63.6	54.7	131.8	64.3	1.8	33.8	2.9	4	clayy SILT to silty CLAY	115	2.0	27	32	13	-	-	4.4	9.9	27	0.070	2.42	15
27.40	60.4	51.9	133.9	61.1	1.8	34.5	3.1	4	clayy SILT to silty CLAY	115	2.0	26	30	12	-	-	4.2	9.9	29	0.070	2.46	15
27.56	60.8	52.1	137.1	61.5	1.9	31.8	3.2	4	clayy SILT to silty CLAY	115	2.0	26	30	13	-	-	4.2	9.9	29	0.070	2.47	15
27.72	60.5	51.8	139.5	61.2	2.0	32.9	3.4	4	clayy SILT to silty CLAY	115	2.0	26	30	13	-	-	4.2	9.9	30	0.070	2.49	15
27.89	58.9	50.3	140.2	59.5	2.0	29.9	3.5	4	clayy SILT to silty CLAY	115	2.0	25	29	12	-	-	4.1	9.9	31	0.070	2.50	15
28.05	57.3	48.9	144.0	57.9	2.1	28.8	3.7	4	clayy SILT to silty CLAY	115	2.0	24	29	12	-	-	4.0	9.9	32	0.070	2.53	15
28.22	56.8	48.3	141.2	57.3	2.0	28.1	3.6	4	clayy SILT to silty CLAY	115	2.0	24	28	12	-	-	3.9	9.9	32	0.070	2.53	15
28.38	54.2	46.1	139.3	54.7	1.9	26.2	3.7	4	clayy SILT to silty CLAY	115	2.0	23	27	11	-	-	3.7	9.9	33	0.070	2.55	15
28.54	56.2	47.7	137.9	56.7	1.9	24.5	3.5	4	clayy SILT to silty CLAY	115	2.0	24	28	12	-	-	3.9	9.9	32	0.070	2.52	15
28.71	53.6	45.4	137.7	54.1	1.9	23.3	3.6	4	clayy SILT to silty CLAY	115	2.0	23	27	11	-	-	3.7	9.9	33	0.070	2.55	15
28.87	52.5	44.4	135.2	52.9	1.8	22.5	3.6	4	clayy SILT to silty CLAY	115	2.0	22	26	11	-	-	3.6	9.9	33	0.070	2.55	15
29.04	52.7	44.5	129.7	53.2	1.7	23.0	3.3	4	clayy SILT to silty CLAY	115	2.0	22	26	11	-	-	3.6	9.9	32	0.070	2.53	15
29.20	53.3	44.9	120.9	53.8	1.5	23.7	2.9	4	clayy SILT to silty CLAY	115	2.0	22	27	11	-	-	3.7	9.9	30	0.070	2.48	15
29.36	54.1	45.5	118.2	54.6	1.4	26.5	2.7	4	clayy SILT to silty CLAY	115	2.0	23	27	11	-	-	3.7	9.9	29	0.070	2.46	15
29.53	55.2	46.4	117.7	55.8	1.4	29.6	2.7	4	clayy SILT to silty CLAY	115	2.0	23	28	11	-	-	3.8	9.9	29	0.070	2.45	15
29.69	52.9	44.4	117.9	53.5	1.4	32.8	2.8	4	clayy SILT to silty CLAY	115	2.0	22	26	11	-	-	3.6	9.9	30	0.070	2.48	15
29.86	51.4	43.1	119.0	52.1	1.4	34.5	2.9	4	clayy SILT to silty CLAY	115	2.0	22	26	10	-	-	3.5	9.9	31	0.070	2.50	15
30.02	49.1	41.0	120.7	49.7	1.4	33.1	3.1	4	clayy SILT to silty CLAY	115	2.0	21	25	10	-	-	3.4	9.9	32	0.070	2.53	15
30.19	47.8	39.9	123.0	48.4	1.5	31.1	3.2	4	clayy SILT to silty CLAY	115	2.0	20	24	10	-	-	3.3	9.9	33	0.070	2.56	15
30.35	47.1	34.7	-	47.7	1.5	30.4	3.4	4	clayy SILT to silty CLAY	115	2.0	17	24	9	-	-	3.2	9.9	36	0.070	2.62	15
30.51	46.9	34.5	-	47.5	1.6	30.9	3.5	4	clayy SILT to silty CLAY	115	2.0	17	23	9	-	-	3.2	9.9	37	0.070	2.63	15
30.68	49.1	40.8	123.6	49.8	1.5	32.2	3.2	4	clayy SILT to silty CLAY	115	2.0	20	25	10	-	-	3.4	9.9	33	0.070	2.55	15
30.84	57.4	47.6	118.9	58.1	1.5	37.1	2.7	4	clayy SILT to silty CLAY	115	2.0	24	29	11	-	-	4.0	9.9	28	0.070	2.44	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

CLU-New Management Building

Project ID: Geolabs WV
Data File: SDF(520).cpt
CPT Date: 3/28/2019 4:41:12 PM
GW During Test: 18 ft

Sounding ID: CPT-02
Project No: 8491.027
Cone/Rig: DDG1471

Depth ft	qc PS tsf	* qc1n PS -	q1ncs PS -	* qt PS tsf	Slv Stss tsf	pore prss (psi)	Frct Ratio %	* Mat Typ Zon	* Material Behavior Description	Unit Wght pcf	Qc to N	* SPT R-N1 60%	SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	Und Shr tsf	OCR -	* Fin Ic %	* D50 - mm	* Ic SBT Indx	* Nk -
31.01	58.5	48.4	119.5	59.2	1.5	40.5	2.7	5	silty SAND to sandy SILT	120	3.0	16	19	11	43	36	-	-	28	0.200	2.44	16
31.17	58.9	48.7	117.9	59.7	1.5	41.8	2.6	5	silty SAND to sandy SILT	120	3.0	16	20	11	43	36	-	-	27	0.200	2.43	16
31.33	56.6	46.7	122.7	57.4	1.6	42.4	2.9	4	clayy SILT to silty CLAY	115	2.0	23	28	11	-	-	3.9	9.9	29	0.070	2.47	15
31.50	49.3	35.5	-	50.1	1.6	37.9	3.3	4	clayy SILT to silty CLAY	115	2.0	18	25	9	-	-	3.4	9.9	35	0.070	2.60	15
31.66	42.3	30.4	-	42.8	1.5	27.8	3.8	4	clayy SILT to silty CLAY	115	2.0	15	21	8	-	-	2.9	9.6	40	0.070	2.69	15
31.83	38.0	27.2	-	38.4	1.5	23.2	4.1	3	silty CLAY to CLAY	115	1.5	18	25	8	-	-	2.6	8.5	43	0.005	2.75	15
31.99	37.1	26.5	-	37.6	1.5	23.9	4.2	3	silty CLAY to CLAY	115	1.5	18	25	7	-	-	2.5	8.3	44	0.005	2.77	15
32.15	37.1	26.4	-	37.6	1.5	24.0	4.1	3	silty CLAY to CLAY	115	1.5	18	25	7	-	-	2.5	8.3	44	0.005	2.77	15
32.32	36.6	25.9	-	37.1	1.5	24.8	4.2	3	silty CLAY to CLAY	115	1.5	17	24	7	-	-	2.5	8.1	45	0.005	2.78	15
32.48	38.0	26.9	-	38.5	2.3	25.7	6.4	3	silty CLAY to CLAY	115	1.5	18	25	8	-	-	2.6	8.4	51	0.005	2.89	15
32.65	54.0	38.0	-	54.4	2.3	24.8	4.3	4	clayy SILT to silty CLAY	115	2.0	19	27	10	-	-	3.7	9.9	38	0.070	2.66	15
32.81	63.7	51.9	141.1	63.9	2.1	9.6	3.4	4	clayy SILT to silty CLAY	115	2.0	26	32	13	-	-	4.4	9.9	30	0.070	2.49	15
32.97	39.1	27.4	-	39.4	1.6	14.7	4.3	3	silty CLAY to CLAY	115	1.5	18	26	8	-	-	2.7	8.6	44	0.005	2.77	15
33.14	36.3	25.3	-	36.7	1.5	19.2	4.4	3	silty CLAY to CLAY	115	1.5	17	24	7	-	-	2.5	7.9	46	0.005	2.80	15
33.30	35.7	24.8	-	36.1	1.5	20.2	4.3	3	silty CLAY to CLAY	115	1.5	17	24	7	-	-	2.4	7.8	46	0.005	2.80	15
33.47	35.3	24.5	-	35.7	1.5	20.4	4.4	3	silty CLAY to CLAY	115	1.5	16	24	7	-	-	2.4	7.6	47	0.005	2.81	15
33.63	35.8	24.8	-	36.2	1.4	20.8	4.3	3	silty CLAY to CLAY	115	1.5	17	24	7	-	-	2.4	7.7	46	0.005	2.80	15
33.79	36.2	25.0	-	36.6	1.4	21.9	4.0	3	silty CLAY to CLAY	115	1.5	17	24	7	-	-	2.5	7.8	45	0.005	2.78	15
33.96	35.9	24.7	-	36.3	1.3	22.5	3.8	4	clayy SILT to silty CLAY	115	2.0	12	18	7	-	-	2.4	7.7	44	0.070	2.77	15
34.12	36.0	24.7	-	36.5	1.3	23.7	3.7	4	clayy SILT to silty CLAY	115	2.0	12	18	7	-	-	2.4	7.7	44	0.070	2.76	15
34.29	39.5	27.0	-	40.0	1.3	25.3	3.6	4	clayy SILT to silty CLAY	115	2.0	14	20	7	-	-	2.7	8.5	41	0.070	2.72	15
34.45	46.3	31.6	-	46.9	1.5	27.1	3.3	4	clayy SILT to silty CLAY	115	2.0	16	23	8	-	-	3.2	9.9	38	0.070	2.64	15
34.61	48.2	38.6	114.5	48.7	1.3	22.4	2.9	4	clayy SILT to silty CLAY	115	2.0	19	24	10	-	-	3.3	9.9	32	0.070	2.54	15
34.78	50.0	40.0	110.7	50.5	1.3	25.2	2.6	4	clayy SILT to silty CLAY	115	2.0	20	25	10	-	-	3.4	9.9	31	0.070	2.50	15
34.94	42.7	28.9	-	43.2	1.2	25.3	2.9	4	clayy SILT to silty CLAY	115	2.0	14	21	8	-	-	2.9	9.1	37	0.070	2.64	15
35.11	40.4	27.2	-	41.0	1.1	32.6	2.8	4	clayy SILT to silty CLAY	115	2.0	14	20	7	-	-	2.7	8.5	38	0.070	2.65	15
35.27	38.6	25.9	-	39.3	1.0	33.4	2.7	4	clayy SILT to silty CLAY	115	2.0	13	19	7	-	-	2.6	8.1	38	0.070	2.65	15
35.43	37.3	25.0	-	38.0	1.1	34.1	3.1	4	clayy SILT to silty CLAY	115	2.0	13	19	7	-	-	2.5	7.8	41	0.070	2.71	15
35.60	42.6	28.5	-	43.4	1.2	38.5	3.0	4	clayy SILT to silty CLAY	115	2.0	14	21	7	-	-	2.9	8.9	38	0.070	2.65	15
35.76	62.6	49.7	119.0	63.6	1.6	50.6	2.6	5	silty SAND to sandy SILT	120	3.0	17	21	12	44	35	-	-	27	0.200	2.42	16
35.93	77.0	61.0	130.2	78.9	1.9	94.3	2.6	5	silty SAND to sandy SILT	120	3.0	20	26	14	51	37	-	-	25	0.200	2.35	16
36.09	66.9	52.9	132.2	68.0	1.9	55.9	3.0	4	clayy SILT to silty CLAY	115	2.0	26	33	13	-	-	4.6	9.9	28	0.070	2.44	15
36.26	57.1	45.1	123.4	57.9	1.6	38.2	3.0	4	clayy SILT to silty CLAY	115	2.0	23	29	11	-	-	3.9	9.9	30	0.070	2.49	15
36.42	45.6	30.0	-	46.4	1.4	39.9	3.1	4	clayy SILT to silty CLAY	115	2.0	15	23	8	-	-	3.1	9.5	38	0.070	2.65	15
36.58	39.1	25.7	-	39.8	1.2	34.9	3.4	4	clayy SILT to silty CLAY	115	2.0	13	20	7	-	-	2.7	8.0	41	0.070	2.72	15
36.75	39.7	26.0	-	40.4	1.2	36.3	3.2	4	clayy SILT to silty CLAY	115	2.0	13	20	7	-	-	2.7	8.1	41	0.070	2.70	15
36.91	44.3	28.9	-	45.1	1.2	40.0	2.9	4	clayy SILT to silty CLAY	115	2.0	14	22	8	-	-	3.0	9.1	37	0.070	2.64	15
37.08	46.2	30.1	-	47.0	1.3	42.6	3.1	4	clayy SILT to silty CLAY	115	2.0	15	23	8	-	-	3.2	9.5	37	0.070	2.64	15
37.24	46.5	30.2	-	47.4	1.5	46.0	3.3	4	clayy SILT to silty CLAY	115	2.0	15	23	8	-	-	3.2	9.5	38	0.070	2.66	15
37.40	47.3	30.6	-	48.3	1.5	48.6	3.2	4	clayy SILT to silty CLAY	115	2.0	15	24	8	-	-	3.2	9.7	38	0.070	2.65	15
37.57	48.0	31.0	-	49.0	1.5	51.5	3.2	4	clayy SILT to silty CLAY	115	2.0	15	24	8	-	-	3.3	9.8	37	0.070	2.64	15
37.73	51.5	33.2	-	52.6	1.5	58.1	3.0	4	clayy SILT to silty CLAY	115	2.0	17	26	8	-	-	3.5	9.9	36	0.070	2.60	15
37.90	54.9	42.7	125.0	56.1	1.7	64.5	3.2	4	clayy SILT to silty CLAY	115	2.0	21	27	11	-	-	3.8	9.9	32	0.070	2.53	15
38.06	55.9	43.5	126.3	57.2	1.7	66.5	3.2	4	clayy SILT to silty CLAY	115	2.0	22	28	11	-	-	3.8	9.9	32	0.070	2.53	15
38.22	54.4	34.7	-	55.8	1.7	68.9	3.2	4	clayy SILT to silty CLAY	115	2.0	17	27	9	-	-	3.7	9.9	35	0.070	2.60	15
38.39	55.5	43.0	123.4	56.8	1.6	67.2	3.1	4	clayy SILT to silty CLAY	115	2.0	21	28	11	-	-	3.8	9.9	32	0.070	2.52	15
38.55	54.4	34.5	-	55.7	1.7	67.5	3.3	4	clayy SILT to silty CLAY	115	2.0	17	27	9	-	-	3.7	9.9	36	0.070	2.62	15
38.72	53.2	33.7	-	54.4	1.9	60.8	3.7	4	clayy SILT to silty CLAY	115	2.0	17	27	9	-	-	3.6	9.9	38	0.070	2.65	15
38.88	51.0	32.2	-	52.0	1.9	53.8	3.9	4	clayy SILT to silty CLAY	115	2.0	16	25	9	-	-	3.5	9.9	40	0.070	2.68	15
39.04	48.4	30.4	-	49.3	1.8	49.8	3.9	4	clayy SILT to silty CLAY	115	2.0	15	24	8	-	-	3.3	9.6	40	0.070	2.70	15
39.21	46.2	29.0	-	47.2	1.6	51.5	3.7	4	clayy SILT to silty CLAY	115	2.0	15	23	8	-	-	3.2	9.1	41	0.070	2.70	15
39.37	44.3	27.8	-	45.4	1.5	52.3	3.6	4	clayy SILT to silty CLAY	115	2.0	14	22	8	-	-	3.0	8.7	41	0.070	2.71	15
39.54	42.8	26.7	-	43.8	1.4	51.4	3.6	4	clayy SILT to silty CLAY	115	2.0	13	21	7	-	-	2.9	8.4	42	0.070	2.72	15
39.70	43.4	27.1	-	44.4	1.4	49.3	3.5	4	clayy SILT to silty CLAY	115	2.0	14	22	7	-	-	3.0	8.5	41	0.070	2.71	15
39.86	46.2	28.7	-	47.3	1.5	52.6	3.5	4	clayy SILT to silty CLAY	115	2.0	14	23	8	-	-	3.2	9.0	40	0.070	2.69	15
40.03	47.1	29.2	-	48.1	1.7	51.8	3.8	4	clayy SILT to silty CLAY	115	2.0	15	24	8	-	-	3.2	9.2	41	0.070	2.71	15
40.19	48.8	30.1	-	49.7	1.8	49.1	3.9	4	clayy SILT to silty CLAY	115	2.0	15	24	8	-	-	3.3	9.5	41	0.070	2.71	15
40.36	49.6	30.6	-	50.5	1.8	46.7	3.8	4	clayy SILT to silty CLAY	115	2.0	15	25	8	-	-	3.4	9.6	40	0.070	2.70	15
40.52	48.5	29.8	-	49.5	1.7	50.9	3.7	4	clayy SILT to silty CLAY	115	2.0	15	24	8	-	-	3.3	9.4	40	0.070	2.70	15
40.68	48.0	29.4	-	49.0	1.6	50.8	3.6	4	clayy SILT to silty CLAY	115	2.0	15	24	8	-	-	3.3	9.2	40	0.070	2.69	15
40.85	47.5	29.0	-	48.6	1.6	54.7	3.6	4	clayy SILT to silty CLAY	115	2.0	15	24	8	-	-	3.2	9.1	40	0.070	2.70	15
41.01	48.1	29.3	-	49.2	1.7	57.1	3.6	4	clayy SILT to silty CLAY	115	2.0	15	24	8	-	-	3.3	9.2	40	0.070	2.70	15
41.18	50.8	30.9	-	52.0	1.7	59.5	3.5	4	clayy SILT to silty CLAY	115	2.0	15	25	8	-	-	3.5	9.7	39	0.070	2.67	15
41.34	54.5	33.1	-	55.9	1.7	67.2	3.2	4	clayy SILT to silty CLAY	115	2.0	17	27	9	-	-	3.7	9.9	36	0.070	2.62	15
41.50	57.0	43.1	124.7	58.5	1.7	74.5	3.1	4	clayy SILT to silty CLAY	115	2.0	22	29	11	-	-	3.9	9.9	32	0.070	2.52	15
41.67	55.7	33.6	-	57.1	1.7	70.7	3.3	4	clayy SILT to silty CLAY	115	2.0	17	28	9	-	-	3.8	9.9	36	0.070	2.62	15
41.83	51.5	31.0	-	52.7	1.8	61.0	3.6	4	clayy SILT to silty CLAY	115	2.0	16	26	8	-	-	3.5	9.8	39	0.070	2.67	15
42.00	49.9	29.9	-	51.1	1.8	62.6	3.7	4	clayy SILT to silty CLAY	115	2.0	15	25	8	-	-	3.4	9.4	40	0.070	2.69	15
42.16	50.4	30.2	-	51.6	1.7	61.5	3.5	4	clayy SILT to silty CLAY	115	2.0	15	25	8	-	-	3.4	9.5	39	0.070	2.68	15
42.32	48.9	29.2	-	50.1	1.6	64.0	3.5	4	clayy SILT to silty CLAY	115	2.0	15	24	8	-	-	3.3	9.2	40	0.070	2.68	15
42.49	46.3	27.6	-	47.6	1.6	63.6	3.6	4	clayy SILT to silty CLAY	115	2.0	14	23	7	-	-	3.2	8.6	41	0.070	2.72	15
42.65	44.5	26.5	-	45.7	1.5	59.8	3.6	4	clayy SILT to silty CLAY	115	2.0	13	22	7	-	-	3.0	8.3	42	0.070	2.73	15
42.82	44.2	26.2	-	45.3	1.5	59.0	3.7	4	clayy SILT to silty CLAY	115	2.0	13	22	7	-	-	3.0	8.2	43	0.070	2.74	15
42.98	45.2	26.7	-	46.4	1.6	63.0	3.6	4	clayy SILT to silty CLAY	115	2.0	13	23	7	-	-	3.1	8.3	42	0.070	2.73	15
43.15	46.5	27.4	-	47.7	1.6	62.1	3.6	4	clayy SILT to silty CLAY	115	2.0	14	23	7	-	-	3.2	8.6	41	0.070	2.72	15
43.31	52.1	30.7	-	53.6	1.7	76.6	3.3	4	clayy SILT to silty CLAY	115	2.0	15	26	8	-	-	3.6	9.6	38	0.070	2.66	15
43.47	52.5	30.8	-	53.9	1.7	70.4	3.4	4	clayy SILT to silty CLAY	115	2.0	15	26	8	-	-	3.6	9.7	39	0.070	2.66	15
43.64	52.1	30.5	-	53.5	1.8	72.6	3.6	4	clayy SILT to silty CLAY	115	2.0	15	26	8	-	-	3.6	9.6	39	0.070	2.68	15
43.80	55.7	32.5	-	57.5	1.9	89.1	3.5	4	clayy SILT to silty CLAY	115	2.0	16	28	9	-	-	3.8	9.9	38	0.070	2.65	15
43.97	61.2	45.4	130.6	63.4	1.9	108.3	3.3	4	clayy SILT to silty CLAY	115	2.0	23	31	11	-	-	4.2	9.9	32	0.070	2.52	15
44.13	69.7	51.6	128.3	72.3	1.9	135.7	2.9	4	clayy SILT to silty CLAY	115	2.0	26	35	12	-	-	4.8	9.9	28	0.070	2.44	15
44.29	86.6	64.0	153.6	90.5	2.8	198.3	3.4	4	clayy SILT to silty CLAY	115	2.0	32	43	15	-	-	6.0	9.9	27	0.070	2.42	15
44.46	118.6	87.6	170.2	123.7	3.6	259.8	3.1	5	silty SAND to sandy SILT	120	3.0	29	40	19	63	38	-	-	22	0.200	2.30	16
44.62	104.3	76.9	179.6	107.2	3.9	148.1	3.8	4	clayy SILT to silty CLAY	115	2.0	38	52	18	-	-	7.2	9.9	27	0.070	2.41	15
44.79	75.3	43.3	-	76.1	3.2	39.8	4.3	4	clayy SILT to silty CLAY	115	2.0	22	38	11	-	-	5.2	9.9	36	0.070	2.62	15
44.95	63.4	36.4	-	64.8	2.5	68.1	4.1	4	clayy SILT to silty CLAY	115	2.0	18	32	10	-	-	4.4	9.9	38	0.070	2.66	15
45.11	62.2	35.6	-	63.6	2.3	74.8	3.8	4	clayy SILT to silty CLAY	115	2.0	18	31	9	-	-	4.3	9.9	38	0.070	2.64	15
45.28	62.5	35.7	-	64.2	2.4	83.2	3.9	4	clayy SILT to silty CLAY	115	2.0	18	31	9	-	-	4.3	9.9	38	0.070	2.65	15
45.44	69.0	39.3	-	70.9	2.7	97.8	4.1	4	clayy SILT to silty CLAY	115	2.0	20	35	10	-	-	4.8	9.9	37	0.070	2.63	15
45.61	98.5	72.1	188.1	102.1	4.2	184.1	4.3	4	clayy SILT to silty CLAY	115	2.0	36	49	17	-	-	6.8	9.9	29	0.070	2.47	15
45.77	122.0	89.2	212.6	126.8	5.4	241.4	4.5	4	clayy SILT to silty CLAY	115	2.0	45	61	21	-	-	8.5	9.9	27	0.070	2.42	15
45.93	144.0	81.4	-	147.9	10.3	194.8	7.3	9	very stiff fine SOIL	120	1.0	81	100	21	-	-	5.0	9.9	36	0.250	2.61	30
46.10	177.2	99.9	-	183.1	15.3	301.4	8.7	9	very stiff fine SOIL	120	1.0	100	100	26	-	-	6.2	9.9	36	0.250	2.62	30
46.26	212.3	154.6	260.4	213.9	7.9	80.3	3.7	8	stiff SAND to clayy SAND	115	5.0	31	42	33	81	41	-	-	19	0.250	2.21	16

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

CLU-New Management Building

Project ID: Geolabs WV
Data File: SDF(520).cpt
CPT Date: 3/28/2019 4:41:12 PM
GW During Test: 18 ft

Sounding ID: CPT-02
Project No: 8491.027
Cone/Rig: DDG1471

. Depth ft	. qc PS tsf	* qcln PS -	. qlncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Mat Typ Zon	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR - -	* Fin Ic %	* D50 - mm	* Ic SBT Indx	* Nk - -
46.43	214.2	155.8	257.8	215.4	7.7	59.1	3.6	8	stiff SAND to clayy SAND	115	5.0	31	43	33	82	41	-	-	19	0.250	2.19	16
46.59	233.8	169.8	254.4	236.9	7.3	156.1	3.2	5	silty SAND to sandy SILT	120	3.0	57	78	35	84	42	-	-	17	0.200	2.12	16
46.75	194.7	141.3	273.9	202.8	8.7	412.9	4.5	9	very stiff fine SOIL	120	1.0	100	100	31	-	-	6.8	9.9	22	0.250	2.30	30
46.92	214.0	155.0	297.9	227.1	10.0	669.9	4.8	9	very stiff fine SOIL	120	1.0	100	100	34	-	-	7.5	9.9	22	0.250	2.29	30
47.08	258.1	186.7	316.5	263.2	11.0	260.7	4.3	9	very stiff fine SOIL	120	1.0	100	100	40	-	-	9.1	9.9	19	0.250	2.21	30
47.25	232.7	168.1	316.8	234.3	11.2	84.2	4.9	9	very stiff fine SOIL	120	1.0	100	100	37	-	-	8.2	9.9	22	0.250	2.28	30
47.41	221.1	159.6	298.3	223.0	10.1	96.7	4.6	9	very stiff fine SOIL	120	1.0	100	100	35	-	-	7.7	9.9	22	0.250	2.27	30
47.57	184.7	133.1	285.7	187.6	9.4	148.2	5.1	9	very stiff fine SOIL	120	1.0	100	100	30	-	-	6.5	9.9	25	0.250	2.36	30
47.74	160.0	115.2	276.8	163.9	8.7	196.7	5.6	9	very stiff fine SOIL	120	1.0	100	100	27	-	-	5.6	9.9	27	0.250	2.42	30
47.90	170.5	122.5	279.7	171.9	9.0	74.2	5.4	9	very stiff fine SOIL	120	1.0	100	100	28	-	-	6.0	9.9	26	0.250	2.39	30
48.07	159.0	114.1	266.8	160.9	8.2	97.0	5.3	9	very stiff fine SOIL	120	1.0	100	100	27	-	-	5.6	9.9	27	0.250	2.41	30
48.23	150.9	108.2	241.6	152.8	7.0	99.1	4.7	9	very stiff fine SOIL	120	1.0	100	100	25	-	-	5.3	9.9	26	0.250	2.38	30
48.39	140.0	100.3	226.4	145.1	6.2	257.1	4.5	9	very stiff fine SOIL	120	1.0	100	100	23	-	-	4.9	9.9	26	0.250	2.39	30
48.56	139.6	99.8	216.9	145.4	5.8	298.4	4.2	9	very stiff fine SOIL	120	1.0	100	100	23	-	-	4.9	9.9	25	0.250	2.36	30
48.72	136.0	97.2	223.3	141.7	6.0	288.9	4.5	9	very stiff fine SOIL	120	1.0	97	100	23	-	-	4.7	9.9	26	0.250	2.40	30
48.89	127.3	90.8	220.0	133.1	5.8	299.5	4.7	9	very stiff fine SOIL	120	1.0	91	100	21	-	-	4.4	9.9	27	0.250	2.43	30
49.05	128.7	91.7	229.9	132.1	6.3	173.1	5.0	9	very stiff fine SOIL	120	1.0	92	100	22	-	-	4.5	9.9	28	0.250	2.45	30
49.22	145.4	103.5	243.3	149.7	7.0	217.9	4.9	9	very stiff fine SOIL	120	1.0	100	100	24	-	-	5.1	9.9	27	0.250	2.41	30
49.38	167.4	119.0	251.5	170.8	7.6	173.7	4.6	9	very stiff fine SOIL	120	1.0	100	100	27	-	-	5.8	9.9	24	0.250	2.35	30
49.54	169.7	120.5	260.9	174.5	8.1	246.0	4.8	9	very stiff fine SOIL	120	1.0	100	100	27	-	-	5.9	9.9	25	0.250	2.36	30
49.71	173.1	122.7	265.1	178.8	8.3	291.3	4.9	9	very stiff fine SOIL	120	1.0	100	100	28	-	-	6.0	9.9	25	0.250	2.36	30
49.87	178.6	126.5	275.4	185.9	8.9	370.1	5.1	9	very stiff fine SOIL	120	1.0	100	100	29	-	-	6.2	9.9	25	0.250	2.37	30
50.04	190.7	134.9	277.5	196.2	9.1	277.8	4.8	9	very stiff fine SOIL	120	1.0	100	100	30	-	-	6.7	9.9	24	0.250	2.33	30
50.20	191.7	135.4	273.6	196.6	8.9	252.5	4.7	9	very stiff fine SOIL	120	1.0	100	100	30	-	-	6.7	9.9	23	0.250	2.32	30
50.36	176.5	124.5	265.9	180.7	8.4	213.8	4.9	9	very stiff fine SOIL	120	1.0	100	100	28	-	-	6.2	9.9	25	0.250	2.35	30
50.53	159.1	112.1	271.4	161.6	8.6	129.6	5.5	9	very stiff fine SOIL	120	1.0	100	100	26	-	-	5.6	9.9	27	0.250	2.43	30

* Indicates the parameter was calculated using the normalized point stress.
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A Professional Engineer must determine their suitability for analysis and design.

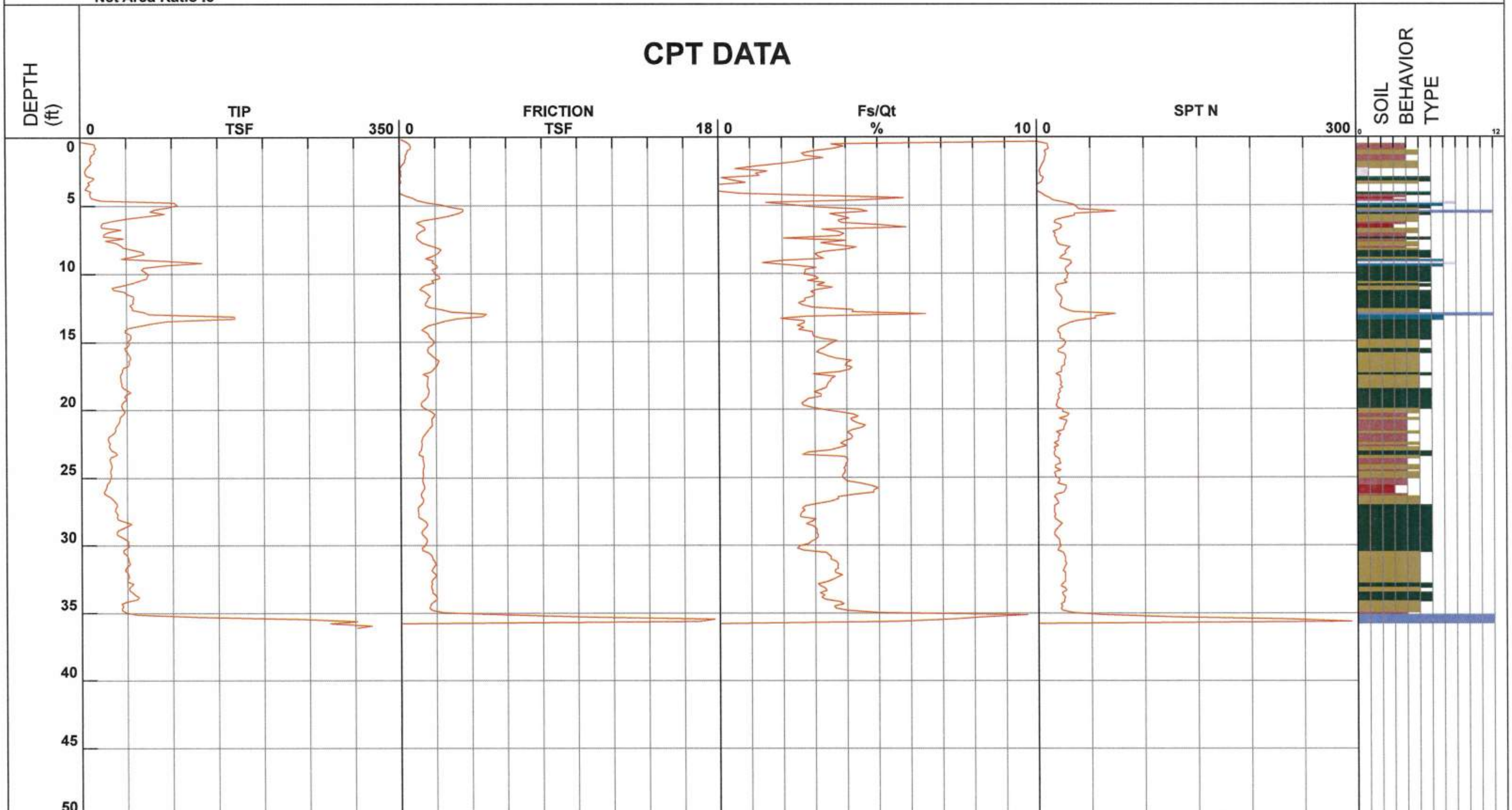
Middle Earth Geo Testing

Geolabs WV

Project	CLU-New Management Building	Operator	BH-ADS	Filename	SDF(519).cpt
Job Number	8491.027	Cone Number	DDG1471	GPS	
Hole Number	CPT-01	Date and Time	3/28/2019 3:08:17 PM	Maximum Depth	36.09 ft
EST GW Depth During Test		18.00 ft			

Net Area Ratio .8

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

CLU-New Management Building

Project ID: Geolabs WV
Data File: SDF(519).cpt
CPT Date: 3/28/2019 3:08:17 PM
GW During Test: 18 ft

Sounding ID: CPT-01
Project No: 8491.027
Cone/Rig: DDG1471

. Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Mat Typ Zon	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR -	* Fin Ic %	* D50 - mm	* Ic SBT Indx	* Nk -
0.33	1.1	0.7	-	1.1	0.4	0.0	9.9	2	Organic SOILS - Peats	100	1.0	1	1	1	-	-	0.1	9.9	95	0.100	4.25	10
0.49	15.9	25.5	-	15.9	0.6	0.0	3.5	4	clayy SILT to silty CLAY	115	2.0	13	8	7	-	-	1.1	9.9	41	0.070	2.72	15
0.66	16.2	25.9	-	16.2	0.6	-0.3	3.9	4	clayy SILT to silty CLAY	115	2.0	13	8	7	-	-	1.1	9.9	43	0.070	2.74	15
0.82	17.3	27.8	-	17.3	0.6	-1.4	3.6	4	clayy SILT to silty CLAY	115	2.0	14	9	7	-	-	1.2	9.9	40	0.070	2.70	15
0.98	15.3	24.5	-	15.3	0.5	-0.5	3.0	4	clayy SILT to silty CLAY	115	2.0	12	8	7	-	-	1.1	9.9	40	0.070	2.69	15
1.15	16.0	25.6	-	15.9	0.4	-0.2	2.6	4	clayy SILT to silty CLAY	115	2.0	13	8	7	-	-	1.1	9.9	37	0.070	2.64	15
1.31	12.5	20.0	-	12.5	0.3	-0.1	2.7	4	clayy SILT to silty CLAY	115	2.0	10	6	5	-	-	0.9	9.9	42	0.070	2.73	15
1.48	11.0	17.7	-	11.0	0.4	0.1	3.3	3	silty CLAY to CLAY	115	1.5	12	7	5	-	-	0.8	9.9	47	0.005	2.83	15
1.64	10.9	17.5	-	10.9	0.3	0.0	2.8	4	clayy SILT to silty CLAY	115	2.0	9	5	5	-	-	0.8	9.9	45	0.070	2.78	15
1.80	12.2	19.5	-	12.2	0.3	0.0	2.4	4	clayy SILT to silty CLAY	115	2.0	10	6	5	-	-	0.9	9.9	41	0.070	2.71	15
1.97	10.8	17.3	-	10.8	0.2	-0.1	1.8	4	clayy SILT to silty CLAY	115	2.0	9	5	5	-	-	0.8	9.9	39	0.070	2.68	15
2.13	8.4	13.5	-	8.4	0.1	0.2	1.1	4	clayy SILT to silty CLAY	115	2.0	7	4	4	-	-	0.6	9.9	39	0.070	2.67	15
2.30	6.4	10.2	-	6.4	0.0	-0.1	0.5	4	clayy SILT to silty CLAY	115	2.0	5	3	3	-	-	0.4	9.9	37	0.070	2.64	15
2.46	5.0	8.0	-	5.0	0.1	0.2	1.6	4	clayy SILT to silty CLAY	115	2.0	4	3	2	-	-	0.3	9.9	55	0.070	2.94	15
2.62	5.5	8.9	-	5.5	0.1	-0.1	1.2	4	clayy SILT to silty CLAY	115	2.0	4	3	3	-	-	0.4	9.9	49	0.070	2.85	15
2.79	7.1	11.4	-	7.1	0.1	0.1	1.3	4	clayy SILT to silty CLAY	115	2.0	6	4	3	-	-	0.5	9.9	44	0.070	2.77	15
2.95	15.3	24.5	35.8	15.3	0.0	0.0	0.1	5	silty SAND to sandy SILT	120	3.0	8	5	5	21	40	-	-	16	0.200	2.10	16
3.12	13.3	21.3	42.3	13.3	0.1	0.0	0.4	5	silty SAND to sandy SILT	120	3.0	7	4	5	16	39	-	-	23	0.200	2.31	16
3.28	8.9	14.3	47.1	8.9	0.1	0.0	0.9	4	clayy SILT to silty CLAY	115	2.0	7	4	4	-	-	0.6	9.9	35	0.070	2.60	15
3.45	10.3	16.5	30.9	10.3	0.0	-0.2	0.1	5	silty SAND to sandy SILT	120	3.0	6	3	4	8	37	-	-	22	0.200	2.28	16
3.61	7.3	11.8	28.5	7.3	0.0	0.1	0.1	5	silty SAND to sandy SILT	120	3.0	4	2	3	5	34	-	-	27	0.200	2.43	16
3.77	5.8	9.2	27.2	5.8	0.0	0.0	0.1	1	sensitive fine SOIL	115	2.0	5	3	2	-	-	0.4	8.5	32	0.005	2.53	15
3.94	11.9	19.1	32.4	11.9	0.0	0.1	0.1	5	silty SAND to sandy SILT	120	3.0	6	4	4	12	37	-	-	19	0.200	2.21	16
4.10	10.4	16.6	45.2	10.4	0.1	0.0	0.7	5	silty SAND to sandy SILT	120	3.0	6	3	4	8	36	-	-	30	0.200	2.49	16
4.27	11.0	17.6	-	11.0	0.3	-0.1	3.2	3	silty CLAY to CLAY	115	1.5	12	7	5	-	-	0.8	9.9	47	0.005	2.82	15
4.43	12.8	20.5	-	12.8	0.7	-0.1	5.9	3	silty CLAY to CLAY	115	1.5	14	9	6	-	-	0.9	9.9	55	0.005	2.94	15
4.59	23.0	37.0	-	23.1	1.0	0.3	4.3	4	clayy SILT to silty CLAY	115	2.0	18	12	10	-	-	1.6	9.9	38	0.070	2.66	15
4.76	102.9	165.1	192.3	103.3	1.5	18.1	1.5	6	clean SAND to silty SAND	125	5.0	33	21	31	84	47	-	-	10	0.350	1.87	16
4.92	106.4	170.7	222.8	106.4	2.4	0.5	2.3	5	silty SAND to sandy SILT	120	3.0	57	35	34	85	47	-	-	13	0.200	2.00	16
5.09	97.0	155.6	231.3	97.1	2.8	1.3	2.9	5	silty SAND to sandy SILT	120	3.0	52	32	32	82	46	-	-	16	0.200	2.12	16
5.25	81.5	130.7	256.5	81.6	3.6	7.7	4.4	9	very stiff fine SOIL	120	1.0	100	81	29	-	-	2.9	9.9	23	0.250	2.30	30
5.41	76.7	123.0	257.5	77.0	3.6	17.7	4.7	9	very stiff fine SOIL	120	1.0	100	77	28	-	-	2.7	9.9	24	0.250	2.34	30
5.58	92.4	148.1	244.2	92.4	3.2	0.2	3.5	8	stiff SAND to clayy SAND	115	5.0	30	18	31	80	46	-	-	19	0.250	2.19	16
5.74	73.4	117.7	222.8	73.3	2.8	-4.6	3.8	8	stiff SAND to clayy SAND	115	5.0	24	15	26	72	45	-	-	22	0.250	2.28	16
5.91	51.0	81.9	192.4	51.0	2.1	-4.3	4.1	4	clayy SILT to silty CLAY	115	2.0	41	26	19	-	-	3.6	9.9	27	0.070	2.41	15
6.07	36.4	58.4	155.8	36.3	1.4	-4.0	3.8	4	clayy SILT to silty CLAY	115	2.0	29	18	14	-	-	2.5	9.9	30	0.070	2.48	15
6.23	25.0	40.1	-	24.9	1.0	-4.3	3.9	4	clayy SILT to silty CLAY	115	2.0	20	12	10	-	-	1.7	9.9	36	0.070	2.61	15
6.40	22.7	36.4	-	22.7	1.1	-1.5	5.1	3	silty CLAY to CLAY	115	1.5	24	15	10	-	-	1.6	9.9	42	0.005	2.72	15
6.56	23.6	37.8	-	23.6	1.4	1.1	6.0	3	silty CLAY to CLAY	115	1.5	25	16	10	-	-	1.6	9.9	44	0.005	2.76	15
6.73	44.7	69.6	155.7	44.7	1.4	0.1	3.3	4	clayy SILT to silty CLAY	115	2.0	35	22	16	-	-	3.1	9.9	26	0.070	2.38	15
6.89	31.3	48.2	143.8	31.4	1.2	2.0	3.8	4	clayy SILT to silty CLAY	115	2.0	24	16	12	-	-	2.2	9.9	33	0.070	2.54	15
7.05	25.8	41.4	-	25.9	1.0	4.2	4.0	4	clayy SILT to silty CLAY	115	2.0	21	13	11	-	-	1.8	9.9	36	0.070	2.60	15
7.22	25.5	40.8	135.0	25.6	1.0	5.4	3.9	4	clayy SILT to silty CLAY	115	2.0	20	13	10	-	-	1.8	9.9	35	0.070	2.60	15
7.38	47.3	70.3	123.9	47.3	1.0	0.6	2.1	5	silty SAND to sandy SILT	120	3.0	23	16	15	55	41	-	-	20	0.200	2.24	16
7.55	27.3	43.9	143.4	27.5	1.1	7.3	4.1	4	clayy SILT to silty CLAY	115	2.0	22	14	11	-	-	1.9	9.9	35	0.070	2.59	15
7.71	39.3	57.2	141.6	40.3	1.3	48.3	3.2	4	clayy SILT to silty CLAY	115	2.0	29	20	14	-	-	2.7	9.9	28	0.070	2.44	15
7.87	43.9	63.1	160.0	44.7	1.6	42.8	3.7	4	clayy SILT to silty CLAY	115	2.0	32	22	15	-	-	3.1	9.9	29	0.070	2.45	15
8.04	47.4	67.5	181.1	48.4	2.0	50.8	4.4	4	clayy SILT to silty CLAY	115	2.0	34	24	16	-	-	3.3	9.9	30	0.070	2.48	15
8.20	57.9	81.7	190.0	59.2	2.3	66.1	4.0	4	clayy SILT to silty CLAY	115	2.0	41	29	19	-	-	4.1	9.9	27	0.070	2.40	15
8.37	68.4	95.4	183.8	69.0	2.2	33.1	3.3	5	silty SAND to sandy SILT	120	3.0	32	23	21	65	42	-	-	22	0.200	2.29	16
8.53	69.8	96.5	177.0	70.1	2.1	16.0	3.0	5	silty SAND to sandy SILT	120	3.0	32	23	21	66	42	-	-	21	0.200	2.26	16
8.69	58.7	80.3	163.4	58.8	1.8	6.1	3.1	5	silty SAND to sandy SILT	120	3.0	27	20	18	60	41	-	-	24	0.200	2.33	16
8.86	44.7	60.6	147.7	44.9	1.5	9.6	3.3	4	clayy SILT to silty CLAY	115	2.0	30	22	14	-	-	3.1	9.9	28	0.070	2.43	15
9.02	95.4	128.1	173.7	97.8	1.9	124.6	2.0	5	silty SAND to sandy SILT	120	3.0	43	32	26	75	44	-	-	14	0.200	2.04	16
9.19	133.6	177.8	200.5	133.6	1.8	-0.6	1.4	6	clean SAND to silty SAND	125	5.0	36	27	33	86	45	-	-	9	0.350	1.83	16
9.35	92.7	122.2	177.1	92.7	2.1	0.4	2.3	5	silty SAND to sandy SILT	120	3.0	41	31	25	74	43	-	-	16	0.200	2.10	16
9.51	69.3	90.5	171.9	69.9	2.1	33.2	3.1	5	silty SAND to sandy SILT	120	3.0	30	23	20	64	42	-	-	22	0.200	2.28	16
9.68	67.0	86.7	158.2	67.0	1.8	2.7	2.7	5	silty SAND to sandy SILT	120	3.0	29	22	19	62	41	-	-	21	0.200	2.26	16
9.84	70.9	91.0	162.5	71.0	1.9	6.8	2.7	5	silty SAND to sandy SILT	120	3.0	30	24	20	64	42	-	-	21	0.200	2.25	16
10.01	74.5	94.8	164.2	75.1	2.0	32.0	2.7	5	silty SAND to sandy SILT	120	3.0	32	25	20	65	42	-	-	20	0.200	2.23	16
10.17	73.3	92.5	173.3	73.9	2.2	32.5	3.1	5	silty SAND to sandy SILT	120	3.0	31	24	20	64	42	-	-	22	0.200	2.28	16
10.34	71.8	89.8	173.5	71.8	2.2	2.9	3.2	5	silty SAND to sandy SILT	120	3.0	30	24	20	63	41	-	-	22	0.200	2.29	16
10.50	64.3	79.9	153.6	64.3	1.8	1.4	2.8	5	silty SAND to sandy SILT	120	3.0	27	21	18	60	41	-	-	22	0.200	2.29	16
10.66	57.5	70.8	159.5	57.6	1.9	4.3	3.4	4	clayy SILT to silty CLAY	115	2.0	35	29	16	-	-	4.0	9.9	26	0.070	2.39	15
10.83	47.0	57.4	139.1	46.9	1.4	-2.1	3.1	4	clayy SILT to silty CLAY	115	2.0	29	23	13	-	-	3.3	9.9	27	0.070	2.43	15
10.99	34.5	41.9	132.4	34.5	1.2	0.0	3.6	4	clayy SILT to silty CLAY	115	2.0	21	17	11	-	-	2.4	9.9	34	0.070	2.57	15
11.16	36.1	43.5	124.9	36.3	1.1	7.4	3.2	4	clayy SILT to silty CLAY	115	2.0	22	18	11	-	-	2.5	9.9	32	0.070	2.52	15
11.32	47.9	57.3	134.2	48.0	1.4	3.9	2.9	4	clayy SILT to silty CLAY	115	2.0	29	24	13	-	-	3.3	9.9	27	0.070	2.41	15
11.48	51.2	60.8	141.1	51.6	1.5	18.2	3.1	4	clayy SILT to silty CLAY	115	2.0	30	26	14	-	-	3.6	9.9	26	0.070	2.40	15
11.65	58.0	68.4	147.1	58.1	1.7	4.2	3.0	5	silty SAND to sandy SILT	120	3.0	23	19	16	54	40	-	-	25	0.200	2.36	16
11.81	58.0	67.9	139.7	59.0	1.6	53.4	2.7	5	silty SAND to sandy SILT	120	3.0	23	19	15	54	40	-	-	24	0.200	2.33	16
11.98	57.0	66.3	138.3	57.4	1.5	21.8	2.7	5	silty SAND to sandy SILT	120	3.0	22	19	15	53	39	-	-	24	0.200	2.34	16
12.14	57.6	66.4	133.0	57.9	1.4	19.0	2.5	5	silty SAND to sandy SILT	120	3.0	22	19	15	54	39	-	-	23	0.200	2.32	16
12.30	54.1	62.1	132.2	55.4	1.4	62.2	2.7	5	silty SAND to sandy SILT	120	3.0	21	18	14	51	39	-	-	25	0.200	2.35	16
12.47	56.2	64.0	142.6	56.5	1.7	16.0	3.0	5	silty SAND to sandy SILT	120	3.0	21	19	15	52	39	-	-	26	0.200	2.38	16
12.63	56.7	64.2	174.9	57.4	2.4	32.6	4.3	4	clayy SILT to silty CLAY	115	2.0	32	28	16	-	-	4.0	9.9	30	0.070	2.49	15
12.80	69.1	77.7	190.3	69.3	2.9	10.2	4.2	4	clayy SILT to silty CLAY	115	2.0	39	35	18	-	-	4.8	9.9	28	0.070	2.43	15
12.96	74.9	83.7	258.7	77.1	4.9	113.8	6.6	9	very stiff fine SOIL	120	1.0	84	75	21	-	-	2.6	9.9	33	0.250	2.56	30
13.12	168.6	187.1	257.1	169.6	4.7	49.6	2.8	5	silty SAND to sandy SILT	120	3.0	62	56	37	88	44	-	-	14	0.200	2.05	16
13.29	168.8	186.1	226.7	168.7	3.3	-1.6	1.9	6	clean SAND to silty SAND	125	5.0	37	34	36	87	44	-	-	11	0.350	1.93	16
13.45	95.6	104.7	174.5	95.7	2.6	3.4	2.7	5	silty SAND to sandy SILT	120	3.0	35	32	22	69	42	-	-	19	0.200	2.20	16
13.62	79.4	86.5	157.1	79.6	2.1	7.5	2.7	5	silty SAND to sandy SILT	120	3.0	29	26	19	62	40	-	-	21	0.200	2.26	16
13.78	65.3	70.6	136.0	66.1	1.6	39.4	2.5	5	silty SAND to sandy SILT	120	3.0	24	22	16	56	39	-	-	22	0.200	2.29	16
13.94	52.9	56.8	128.1	54.6	1.4	87.5	2.7	5	silty SAND to sandy SILT	120	3.0	19	18	13	48	38	-	-	26	0.200	2.39	16
14.11	48.5	51.9	119.5	50.1	1.2	78.4	2.5	5	silty SAND to sandy SILT	120	3.0	17	16	12	45	38	-	-	26	0.200	2.40	16
14.27	48.6	51.6	129.7	50.0	1.4	74.7	3.0	4	clayy SILT to silty CLAY	115	2.0	26	24	12	-	-	3.4	9.9	28	0.070	2.45	15
14.44	53.8	56.9	135.5	54.4	1.6	27.6	3.0	4	clayy SILT to silty CLAY	115	2.0	28	27	13	-	-	3.7	9.9	27	0.070	2.42	15
14.60	55.1	57.9	137.1	55.0	1.6	-2.6	3.0	4	clayy SILT to silty CLAY	115	2.0	29	28	14	-	-	3.8	9.9	27	0.070	2.41	15
14.76	54.2	56.7	142.6	54.3	1.8	3.8	3.3	4	clayy SILT to silty CLAY	115	2.0	28	27	13	-	-	3.8	9.9	28	0.070	2.45	15
14.93	51.5	53.5	149.9	51.8	1.9	13.6	3.8	4	clayy SILT to silty CLAY	115	2.0	27	26	13	-	-	3.6	9.9	31	0.070	2.51	15
15.09	53.4	55.2	148.3	53.4	1.9	-1.8	3.6	4	clayy SILT to silty CLAY	115	2.0	28	27	13	-	-	3.7	9.9	30	0.070	2.48	15
15.26	51.8	53.3	142.6	52.0	1.8	10.3	3.5	4	clayy SILT to silty CLAY	115	2.0	27	26	13	-	-	3.6	9.9	30	0.070	2.48	15
15.42	47.9	49.0	135.8	48.0	1.6	6.8	3.4	4	clayy SILT to silty CLAY	115	2.0	24	24	12	-	-	3.3	9.9	31	0.070	2.50	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

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Project No: 8491.027
Cone/Rig: DDG1471

. Depth ft	. qc PS tsf	* qc1n PS -	. q1ncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Mat Typ Zon	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR -	* Fin Ic %	* D50 - mm	* Ic SBT Indx	* Nk -
15.58	48.5	49.4	132.9	48.7	1.5	8.1	3.2	4	clayy SILT to silty CLAY	115	2.0	25	24	12	-	-	3.4	9.9	30	0.070	2.48	15
15.75	50.9	51.5	132.7	50.9	1.6	1.1	3.1	4	clayy SILT to silty CLAY	115	2.0	26	25	12	-	-	3.5	9.9	29	0.070	2.46	15
15.91	52.4	52.8	139.1	52.4	1.7	-0.3	3.3	4	clayy SILT to silty CLAY	115	2.0	26	26	13	-	-	3.6	9.9	29	0.070	2.47	15
16.08	54.0	54.1	144.9	54.0	1.9	0.2	3.5	4	clayy SILT to silty CLAY	115	2.0	27	27	13	-	-	3.7	9.9	30	0.070	2.48	15
16.24	54.2	54.0	150.2	54.1	2.0	-3.3	3.7	4	clayy SILT to silty CLAY	115	2.0	27	27	13	-	-	3.8	9.9	31	0.070	2.50	15
16.40	52.3	51.9	158.2	52.3	2.2	-1.3	4.2	4	clayy SILT to silty CLAY	115	2.0	26	26	13	-	-	3.6	9.9	33	0.070	2.55	15
16.57	53.1	52.4	155.4	53.1	2.1	-0.2	4.1	4	clayy SILT to silty CLAY	115	2.0	26	27	13	-	-	3.7	9.9	32	0.070	2.54	15
16.73	51.9	51.0	152.8	51.8	2.1	-4.2	4.0	4	clayy SILT to silty CLAY	115	2.0	25	26	13	-	-	3.6	9.9	33	0.070	2.54	15
16.90	46.4	45.4	150.1	46.4	1.9	-0.3	4.3	4	clayy SILT to silty CLAY	115	2.0	23	23	12	-	-	3.2	9.9	35	0.070	2.60	15
17.06	45.1	44.5	147.0	45.1	1.8	1.8	4.2	4	clayy SILT to silty CLAY	115	2.0	22	23	11	-	-	3.1	9.9	35	0.070	2.60	15
17.23	45.1	43.7	139.5	45.1	1.7	1.5	3.9	4	clayy SILT to silty CLAY	115	2.0	22	23	11	-	-	3.1	9.9	34	0.070	2.58	15
17.39	43.4	41.8	119.9	43.4	1.3	3.0	3.0	4	clayy SILT to silty CLAY	115	2.0	21	22	10	-	-	3.0	9.9	32	0.070	2.52	15
17.55	43.1	41.4	133.8	43.1	1.6	3.0	3.7	4	clayy SILT to silty CLAY	115	2.0	21	22	10	-	-	3.0	9.9	35	0.070	2.58	15
17.72	43.7	41.8	132.0	43.9	1.5	8.1	3.6	4	clayy SILT to silty CLAY	115	2.0	21	22	11	-	-	3.0	9.9	34	0.070	2.57	15
17.88	43.6	41.5	130.9	43.9	1.5	15.2	3.6	4	clayy SILT to silty CLAY	115	2.0	21	22	10	-	-	3.0	9.9	34	0.070	2.57	15
18.05	44.6	42.4	130.6	45.2	1.5	26.4	3.5	4	clayy SILT to silty CLAY	115	2.0	21	22	11	-	-	3.1	9.9	33	0.070	2.56	15
18.21	44.3	41.9	129.4	44.9	1.5	33.9	3.5	4	clayy SILT to silty CLAY	115	2.0	21	22	10	-	-	3.1	9.9	33	0.070	2.56	15
18.37	46.4	43.9	130.9	47.4	1.6	52.0	3.4	4	clayy SILT to silty CLAY	115	2.0	22	23	11	-	-	3.2	9.9	33	0.070	2.54	15
18.54	50.5	47.7	131.6	51.9	1.6	66.7	3.2	4	clayy SILT to silty CLAY	115	2.0	24	25	12	-	-	3.5	9.9	31	0.070	2.50	15
18.70	54.3	51.1	130.5	55.0	1.6	38.0	3.0	4	clayy SILT to silty CLAY	115	2.0	26	27	12	-	-	3.8	9.9	29	0.070	2.46	15
18.87	49.0	46.0	130.0	50.3	1.6	68.0	3.3	4	clayy SILT to silty CLAY	115	2.0	23	24	11	-	-	3.4	9.9	31	0.070	2.51	15
19.03	47.6	44.7	128.7	48.9	1.5	62.6	3.3	4	clayy SILT to silty CLAY	115	2.0	22	24	11	-	-	3.3	9.9	32	0.070	2.52	15
19.19	50.3	47.1	122.6	52.0	1.4	87.4	2.9	4	clayy SILT to silty CLAY	115	2.0	24	25	11	-	-	3.5	9.9	29	0.070	2.47	15
19.36	46.8	43.7	116.6	47.6	1.3	37.7	2.8	4	clayy SILT to silty CLAY	115	2.0	22	23	11	-	-	3.2	9.9	30	0.070	2.48	15
19.52	45.0	41.9	112.2	46.0	1.2	48.8	2.7	4	clayy SILT to silty CLAY	115	2.0	21	23	10	-	-	3.1	9.9	30	0.070	2.48	15
19.69	44.2	41.2	112.7	45.2	1.2	48.0	2.7	4	clayy SILT to silty CLAY	115	2.0	21	22	10	-	-	3.0	9.9	30	0.070	2.49	15
19.85	45.3	42.1	119.9	46.2	1.3	46.2	3.0	4	clayy SILT to silty CLAY	115	2.0	21	23	10	-	-	3.1	9.9	31	0.070	2.52	15
20.01	47.2	43.8	130.0	47.7	1.6	24.4	3.4	4	clayy SILT to silty CLAY	115	2.0	22	24	11	-	-	3.3	9.9	32	0.070	2.54	15
20.18	47.5	44.0	139.4	47.5	1.8	-1.9	3.8	4	clayy SILT to silty CLAY	115	2.0	22	24	11	-	-	3.3	9.9	34	0.070	2.57	15
20.34	45.6	41.2	-	45.6	1.9	-1.0	4.3	4	clayy SILT to silty CLAY	115	2.0	21	23	11	-	-	3.1	9.9	37	0.070	2.63	15
20.51	42.8	38.5	-	42.8	1.9	-0.7	4.5	4	clayy SILT to silty CLAY	115	2.0	19	21	10	-	-	2.9	9.9	39	0.070	2.66	15
20.67	42.3	37.9	-	42.5	1.7	8.2	4.2	4	clayy SILT to silty CLAY	115	2.0	19	21	10	-	-	2.9	9.9	38	0.070	2.65	15
20.83	42.2	37.6	-	42.4	1.8	12.4	4.3	4	clayy SILT to silty CLAY	115	2.0	19	21	10	-	-	2.9	9.9	38	0.070	2.66	15
21.00	40.9	36.4	-	41.3	1.8	19.3	4.5	4	clayy SILT to silty CLAY	115	2.0	18	20	10	-	-	2.8	9.9	40	0.070	2.68	15
21.16	38.8	34.3	-	38.9	1.8	5.9	4.7	3	silty CLAY to CLAY	115	1.5	23	26	9	-	-	2.7	9.9	41	0.005	2.72	15
21.33	37.3	32.9	-	37.5	1.7	14.0	4.6	3	silty CLAY to CLAY	115	1.5	22	25	9	-	-	2.6	9.9	42	0.005	2.72	15
21.49	37.6	33.1	-	37.9	1.6	15.4	4.3	4	clayy SILT to silty CLAY	115	2.0	17	19	9	-	-	2.6	9.9	41	0.070	2.70	15
21.65	36.4	31.9	-	36.6	1.5	7.7	4.2	4	clayy SILT to silty CLAY	115	2.0	16	18	9	-	-	2.5	9.9	41	0.070	2.70	15
21.82	33.0	28.8	-	33.1	1.4	4.3	4.3	3	silty CLAY to CLAY	115	1.5	19	22	8	-	-	2.3	9.1	43	0.005	2.75	15
21.98	30.1	26.2	-	30.3	1.3	8.3	4.4	3	silty CLAY to CLAY	115	1.5	17	20	7	-	-	2.0	8.3	45	0.005	2.78	15
22.15	29.3	25.4	-	29.5	1.2	11.3	4.3	3	silty CLAY to CLAY	115	1.5	17	20	7	-	-	2.0	8.0	45	0.005	2.79	15
22.31	30.1	25.9	-	30.5	1.2	20.3	4.1	3	silty CLAY to CLAY	115	1.5	17	20	7	-	-	2.0	8.2	44	0.005	2.77	15
22.47	31.6	27.1	-	31.9	1.2	15.2	4.0	4	clayy SILT to silty CLAY	115	2.0	14	16	7	-	-	2.1	8.6	43	0.070	2.74	15
22.64	30.2	25.8	-	30.4	1.2	13.5	4.2	3	silty CLAY to CLAY	115	1.5	17	20	7	-	-	2.0	8.1	45	0.005	2.77	15
22.80	31.4	26.8	-	32.0	1.2	29.6	3.9	4	clayy SILT to silty CLAY	115	2.0	13	16	7	-	-	2.1	8.5	43	0.070	2.75	15
22.97	33.0	28.1	-	33.9	1.2	41.2	3.6	4	clayy SILT to silty CLAY	115	2.0	14	17	8	-	-	2.3	8.9	41	0.070	2.71	15
23.13	37.9	33.9	108.2	38.9	1.1	52.0	2.9	4	clayy SILT to silty CLAY	115	2.0	17	19	9	-	-	2.6	9.9	34	0.070	2.58	15
23.30	39.3	35.0	106.0	39.7	1.0	19.8	2.7	4	clayy SILT to silty CLAY	115	2.0	18	20	9	-	-	2.7	9.9	33	0.070	2.55	15
23.46	32.6	27.4	-	33.2	1.3	30.8	4.1	3	silty CLAY to CLAY	115	1.5	18	22	8	-	-	2.2	8.7	43	0.005	2.75	15
23.62	31.1	26.0	-	31.7	1.2	32.2	4.2	3	silty CLAY to CLAY	115	1.5	17	21	7	-	-	2.1	8.2	45	0.005	2.78	15
23.79	31.6	26.4	-	32.0	1.3	19.7	4.2	3	silty CLAY to CLAY	115	1.5	18	21	7	-	-	2.2	8.3	44	0.005	2.77	15
23.95	32.7	27.2	-	33.0	1.3	15.8	4.1	3	silty CLAY to CLAY	115	1.5	18	22	8	-	-	2.2	8.6	44	0.005	2.76	15
24.12	33.3	27.6	-	33.8	1.3	26.0	4.1	3	silty CLAY to CLAY	115	1.5	18	22	8	-	-	2.3	8.7	43	0.005	2.75	15
24.28	33.0	27.2	-	33.2	1.3	11.9	4.1	4	clayy SILT to silty CLAY	115	2.0	14	17	8	-	-	2.2	8.6	43	0.070	2.75	15
24.44	31.9	26.3	-	32.3	1.3	19.8	4.1	3	silty CLAY to CLAY	115	1.5	18	21	7	-	-	2.2	8.3	44	0.005	2.77	15
24.61	31.9	26.2	-	32.5	1.3	27.3	4.1	3	silty CLAY to CLAY	115	1.5	17	21	7	-	-	2.2	8.3	44	0.005	2.77	15
24.77	32.7	26.7	-	33.0	1.3	15.0	4.0	4	clayy SILT to silty CLAY	115	2.0	13	16	7	-	-	2.2	8.4	43	0.070	2.76	15
24.94	32.4	26.4	-	32.6	1.3	9.1	4.0	3	silty CLAY to CLAY	115	1.5	18	22	7	-	-	2.2	8.3	44	0.005	2.76	15
25.10	31.2	25.3	-	31.5	1.2	16.6	4.1	3	silty CLAY to CLAY	115	1.5	17	21	7	-	-	2.1	8.0	45	0.005	2.78	15
25.26	30.7	24.8	-	30.9	1.2	13.0	4.2	3	silty CLAY to CLAY	115	1.5	17	20	7	-	-	2.1	7.8	45	0.005	2.79	15
25.43	28.6	23.0	-	28.7	1.3	5.9	4.7	3	silty CLAY to CLAY	115	1.5	15	19	7	-	-	1.9	7.2	49	0.005	2.85	15
25.59	27.6	22.1	-	27.5	1.3	-1.7	5.1	3	silty CLAY to CLAY	115	1.5	15	18	7	-	-	1.9	6.9	51	0.005	2.88	15
25.76	27.2	21.8	-	27.2	1.3	-2.0	5.2	3	silty CLAY to CLAY	115	1.5	15	18	7	-	-	1.8	6.8	52	0.005	2.90	15
25.92	26.1	20.8	-	26.0	1.3	-2.5	5.1	3	silty CLAY to CLAY	115	1.5	14	17	6	-	-	1.8	6.5	53	0.005	2.91	15
26.08	24.6	19.6	-	24.6	1.2	-1.1	5.1	3	silty CLAY to CLAY	115	1.5	13	16	6	-	-	1.7	6.1	54	0.005	2.93	15
26.25	26.9	21.3	-	27.5	1.1	29.3	4.5	3	silty CLAY to CLAY	115	1.5	14	18	6	-	-	1.8	6.6	50	0.005	2.86	15
26.41	31.7	25.0	-	32.4	1.2	33.3	3.9	4	clayy SILT to silty CLAY	115	2.0	13	16	7	-	-	2.2	7.9	44	0.070	2.77	15
26.58	34.3	27.0	-	35.3	1.3	51.9	3.9	4	clayy SILT to silty CLAY	115	2.0	13	17	7	-	-	2.3	8.5	43	0.070	2.74	15
26.74	36.5	28.6	-	37.5	1.3	52.2	3.6	4	clayy SILT to silty CLAY	115	2.0	14	18	8	-	-	2.5	9.0	41	0.070	2.70	15
26.90	38.6	30.2	-	40.1	1.2	72.2	3.2	4	clayy SILT to silty CLAY	115	2.0	15	19	8	-	-	2.6	9.6	38	0.070	2.65	15
27.07	39.0	30.4	-	40.7	1.1	89.0	2.8	4	clayy SILT to silty CLAY	115	2.0	15	19	8	-	-	2.7	9.6	36	0.070	2.61	15
27.23	37.4	29.0	-	39.1	1.0	85.9	2.7	4	clayy SILT to silty CLAY	115	2.0	15	19	7	-	-	2.6	9.2	36	0.070	2.61	15
27.40	36.8	28.4	-	38.7	1.0	98.6	2.8	4	clayy SILT to silty CLAY	115	2.0	14	18	7	-	-	2.5	9.0	37	0.070	2.63	15
27.56	38.3	29.5	-	40.1	1.0	90.3	2.7	4	clayy SILT to silty CLAY	115	2.0	15	19	8	-	-	2.6	9.3	36	0.070	2.61	15
27.72	39.7	33.8	103.7	41.2	1.0	76.2	2.6	4	clayy SILT to silty CLAY	115	2.0	17	20	8	-	-	2.7	9.7	33	0.070	2.56	15
27.89	38.9	33.1	102.9	40.5	1.0	81.0	2.6	4	clayy SILT to silty CLAY	115	2.0	17	19	8	-	-	2.7	9.4	34	0.070	2.56	15
28.05	39.8	30.4	-	41.4	1.2	81.0	3.1	4	clayy SILT to silty CLAY	115	2.0	15	20	8	-	-	2.7	9.6	37	0.070	2.64	15
28.22	46.9	39.8	118.1	49.1	1.4	111.5	3.0	4	clayy SILT to silty CLAY	115	2.0	20	23	10	-	-	3.2	9.9	32	0.070	2.54	15
28.38	55.0	46.5	120.6	56.7	1.5	89.5	2.8	4	clayy SILT to silty CLAY	115	2.0	23	27	11	-	-	3.8	9.9	29	0.070	2.46	15
28.54	50.6	42.7	121.5	52.1	1.5	78.9	3.0	4	clayy SILT to silty CLAY	115	2.0	21	25	10	-	-	3.5	9.9	31	0.070	2.51	15
28.71	45.1	34.0	-	46.1	1.4	51.9	3.1	4	clayy SILT to silty CLAY	115	2.0	17	23	9	-	-	3.1	9.9	35	0.070	2.60	15
28.87	40.2	30.1	-	41.1	1.2	47.6	3.2	4	clayy SILT to silty CLAY	115	2.0	15	20	8	-	-	2.7	9.5	38	0.070	2.65	15
29.04	38.3	28.7	-	39.6	1.2	67.3	3.2	4	clayy SILT to silty CLAY	115	2.0	14	19	8	-	-	2.6	9.0	39	0.070	2.66	15
29.20	39.2	29.3	-	40.7	1.2	74.0	3.2	4	clayy SILT to silty CLAY	115	2.0	15	20	8	-	-	2.7	9.2	38	0.070	2.66	15
29.36	43.8	32.6	-	45.5	1.4	85.4	3.2	4	clayy SILT to silty CLAY	115	2.0	16	22	8	-	-	3.0	9.9	36	0.070	2.62	15
29.53	48.5	40.6	121.4	50.7	1.5	109.9	3.1	4	clayy SILT to silty CLAY	115	2.0	20	24	10	-	-	3.3	9.9	33	0.070	2.54	15
29.69	51.3	42.8	120.8	53.2	1.5	100.5	3.0	4	clayy SILT to silty CLAY	115	2.0	21	26	10	-	-	3.5	9.9	31	0.070	2.51	15
29.86	50.9	42.4	118.4	52.9	1.4	103.4	2.9	4	clayy SILT to silty CLAY	115	2.0	21	25	10	-	-	3.5	9.9	31	0.070	2.50	15
30.02	52.3	43.5	113.7	54.6	1.3	114.9	2.6	4	clayy SILT to silty CLAY	115	2.0	22	26	10	-	-	3.6	9.9	29	0.070	2.47	15
30.19	49.2	40.9	108.7	51.0	1.2	91.7	2.5	4	clayy SILT to silty CLAY	115	2.0	20	25	10	-	-	3.4	9.9	30	0.070	2.48	15
30.35	45.6	37.8	110.3	47.5	1.2	100.0	2.7	4	clayy SILT to silty CLAY	115	2.0	19	23	9	-	-	3.1	9.9	32	0.070	2.53	15
30.51	46.1	33.5	-	48.3	1.5	114.8	3.5	4	clayy SILT to silty CLAY	115	2.0	17	23	9	-	-	3.2	9.9	37	0.070	2.64	15
30.68	49.4	35.8	-	51.3	1.7	98.5	3.6	4	clayy SILT to silty CLAY	115	2.0	18	25	9	-	-	3.4	9.9	36	0.070	2.62	15
30.84	50.6	36.6	-	51.8	1.8	63.3	3.6	4	clayy SILT to silty CLAY	115	2.0	18	25	9	-	-	3.5	9.9	36	0.070	2.62	15

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

CLU-New Management Building

Project ID: Geolabs WV
Data File: SDF(519).cpt
CPT Date: 3/28/2019 3:08:17 PM
GW During Test: 18 ft

Page: 3
Sounding ID: CPT-01
Project No: 8491.027
Cone/Rig: DDG1471

. . Depth ft	. qc PS tsf	* qcln PS -	. qlncs PS -	* qt PS tsf	. Slv Stss tsf	. pore prss (psi)	. Frct Rato %	* Mat Typ Zon	* Material Behavior Description	. Unit Wght pcf	. Qc to N	* SPT R-N1 60%	. SPT R-N 60%	* SPT IcN1 60%	* Rel Den %	* Ftn Ang deg	. Und Shr tsf	. OCR - -	* Fin Ic %	* D50 - mm	* Ic SBT Indx	* Nk - -
31.01	51.3	37.0	-	52.8	1.8	73.3	3.6	4	clayy SILT to silty CLAY	115	2.0	18	26	10	-	-	3.5	9.9	36	0.070	2.61	15
31.17	51.6	37.1	-	53.6	1.9	100.4	3.8	4	clayy SILT to silty CLAY	115	2.0	19	26	10	-	-	3.5	9.9	37	0.070	2.63	15
31.33	53.1	38.0	-	54.9	2.0	93.7	3.8	4	clayy SILT to silty CLAY	115	2.0	19	27	10	-	-	3.7	9.9	37	0.070	2.62	15
31.50	51.0	36.4	-	52.5	1.9	78.0	3.8	4	clayy SILT to silty CLAY	115	2.0	18	25	9	-	-	3.5	9.9	37	0.070	2.64	15
31.66	48.6	34.6	-	49.6	1.8	51.9	3.9	4	clayy SILT to silty CLAY	115	2.0	17	24	9	-	-	3.3	9.9	38	0.070	2.66	15
31.83	47.9	34.0	-	49.3	1.7	70.5	3.8	4	clayy SILT to silty CLAY	115	2.0	17	24	9	-	-	3.3	9.9	38	0.070	2.65	15
31.99	50.5	35.7	-	52.2	1.8	90.8	3.8	4	clayy SILT to silty CLAY	115	2.0	18	25	9	-	-	3.5	9.9	37	0.070	2.64	15
32.15	51.5	36.3	-	52.9	2.0	74.2	4.0	4	clayy SILT to silty CLAY	115	2.0	18	26	10	-	-	3.5	9.9	38	0.070	2.65	15
32.32	51.9	36.5	-	53.3	1.9	69.2	3.8	4	clayy SILT to silty CLAY	115	2.0	18	26	10	-	-	3.6	9.9	37	0.070	2.64	15
32.48	50.4	35.3	-	51.7	1.8	65.8	3.7	4	clayy SILT to silty CLAY	115	2.0	18	25	9	-	-	3.5	9.9	37	0.070	2.64	15
32.65	50.5	35.3	-	52.4	1.7	100.5	3.5	4	clayy SILT to silty CLAY	115	2.0	18	25	9	-	-	3.5	9.9	36	0.070	2.62	15
32.81	56.8	46.0	129.3	57.8	1.8	53.5	3.2	4	clayy SILT to silty CLAY	115	2.0	23	28	11	-	-	3.9	9.9	31	0.070	2.51	15
32.97	54.1	43.8	128.7	54.6	1.7	23.3	3.3	4	clayy SILT to silty CLAY	115	2.0	22	27	11	-	-	3.7	9.9	32	0.070	2.53	15
33.14	51.8	35.8	-	53.5	1.7	87.6	3.4	4	clayy SILT to silty CLAY	115	2.0	18	26	9	-	-	3.6	9.9	36	0.070	2.61	15
33.30	52.8	36.4	-	54.9	1.8	107.9	3.5	4	clayy SILT to silty CLAY	115	2.0	18	26	9	-	-	3.6	9.9	36	0.070	2.61	15
33.47	56.0	45.1	129.7	58.1	1.8	105.3	3.3	4	clayy SILT to silty CLAY	115	2.0	23	28	11	-	-	3.9	9.9	32	0.070	2.52	15
33.63	58.6	47.2	135.2	60.8	1.9	110.1	3.4	4	clayy SILT to silty CLAY	115	2.0	24	29	12	-	-	4.0	9.9	32	0.070	2.52	15
33.79	63.0	50.6	136.8	65.8	2.0	144.6	3.3	4	clayy SILT to silty CLAY	115	2.0	25	31	12	-	-	4.3	9.9	30	0.070	2.49	15
33.96	60.8	48.8	137.5	62.4	2.0	78.7	3.4	4	clayy SILT to silty CLAY	115	2.0	24	30	12	-	-	4.2	9.9	31	0.070	2.51	15
34.12	49.1	33.4	-	49.5	1.8	20.0	3.9	4	clayy SILT to silty CLAY	115	2.0	17	25	9	-	-	3.4	9.9	39	0.070	2.67	15
34.29	43.6	29.6	-	44.3	1.7	33.1	4.1	4	clayy SILT to silty CLAY	115	2.0	15	22	8	-	-	3.0	9.3	42	0.070	2.72	15
34.45	45.5	30.8	-	46.7	1.6	61.5	3.8	4	clayy SILT to silty CLAY	115	2.0	15	23	8	-	-	3.1	9.7	40	0.070	2.69	15
34.61	44.1	29.7	-	44.9	1.6	43.1	3.8	4	clayy SILT to silty CLAY	115	2.0	15	22	8	-	-	3.0	9.4	41	0.070	2.70	15
34.78	44.2	29.7	-	45.3	1.8	57.7	4.2	4	clayy SILT to silty CLAY	115	2.0	15	22	8	-	-	3.0	9.4	42	0.070	2.73	15
34.94	48.9	32.8	-	50.9	2.4	102.4	5.2	3	silty CLAY to CLAY	115	1.5	22	33	9	-	-	3.3	9.9	44	0.005	2.76	15
35.11	61.6	41.2	-	64.7	5.9	155.7	10.0	3	silty CLAY to CLAY	115	1.5	27	41	12	-	-	4.2	9.9	52	0.005	2.90	15
35.27	130.0	86.7	-	135.0	10.7	255.2	8.4	9	very stiff fine SOIL	120	1.0	87	100	23	-	-	4.5	9.9	37	0.250	2.64	30
35.43	243.0	192.4	445.8	247.2	17.7	211.3	7.3	9	very stiff fine SOIL	120	1.0	100	100	45	-	-	8.5	9.9	26	0.250	2.40	30
35.60	301.9	238.7	430.8	308.7	16.8	346.2	5.6	9	very stiff fine SOIL	120	1.0	100	100	52	-	-	10.6	9.9	21	0.250	2.25	30

* Indicates the parameter was calculated using the normalized point stress.
The parameters listed above were determined using empirical correlations.
A Professional Engineer must determine their suitability for analysis and design.

Middle Earth Geo Testing

Appendix B
Laboratory Testing

W.O. 8491
April 29, 2019

Laboratory Test Summary

Excavation: B1 (TD= 45 ft, GW @ 18 ft)

Depth	Geology	Sample Description	ST	w	DD	S	Max	Opt	EI	LL	PI	% Gravel	% Sand	%Fines	W.O. 8491.027
2.5	Alluvium	fat CLAY	(U)	25.4	102.5	100									
5	Alluvium	fat CLAY	(B)				111.0	14.5	104	44	27	2	21	77	
5	Alluvium	lean CLAY	(U)	19	107.4	91									
7.5	Alluvium	sandy SILT	(U)	19	107.9	93									
10	Older Alluvium	SAND	(S)	34											
12.5	Older Alluvium	lean CLAY	(S)	30.4											
15	Older Alluvium	lean CLAY	(U)	34	86.7	98									
20	Older Alluvium	fine sandy SILT	(S)	34.1						71	50		8	92	
25	Older Alluvium	CLAY	(S)	39.3											
30	Older Alluvium	fat CLAY	(U)	25.3	98.9	98									
35	Older Alluvium	lean CLAY	(S)	32.6											
40	Older Alluvium	silty SAND	(S)	26.1											
45	Older Alluvium	sandy lean CLAY	(S)	33.9											
49	Older Alluvium	SILT	(U)	27.4	95.5	98									

LEGEND

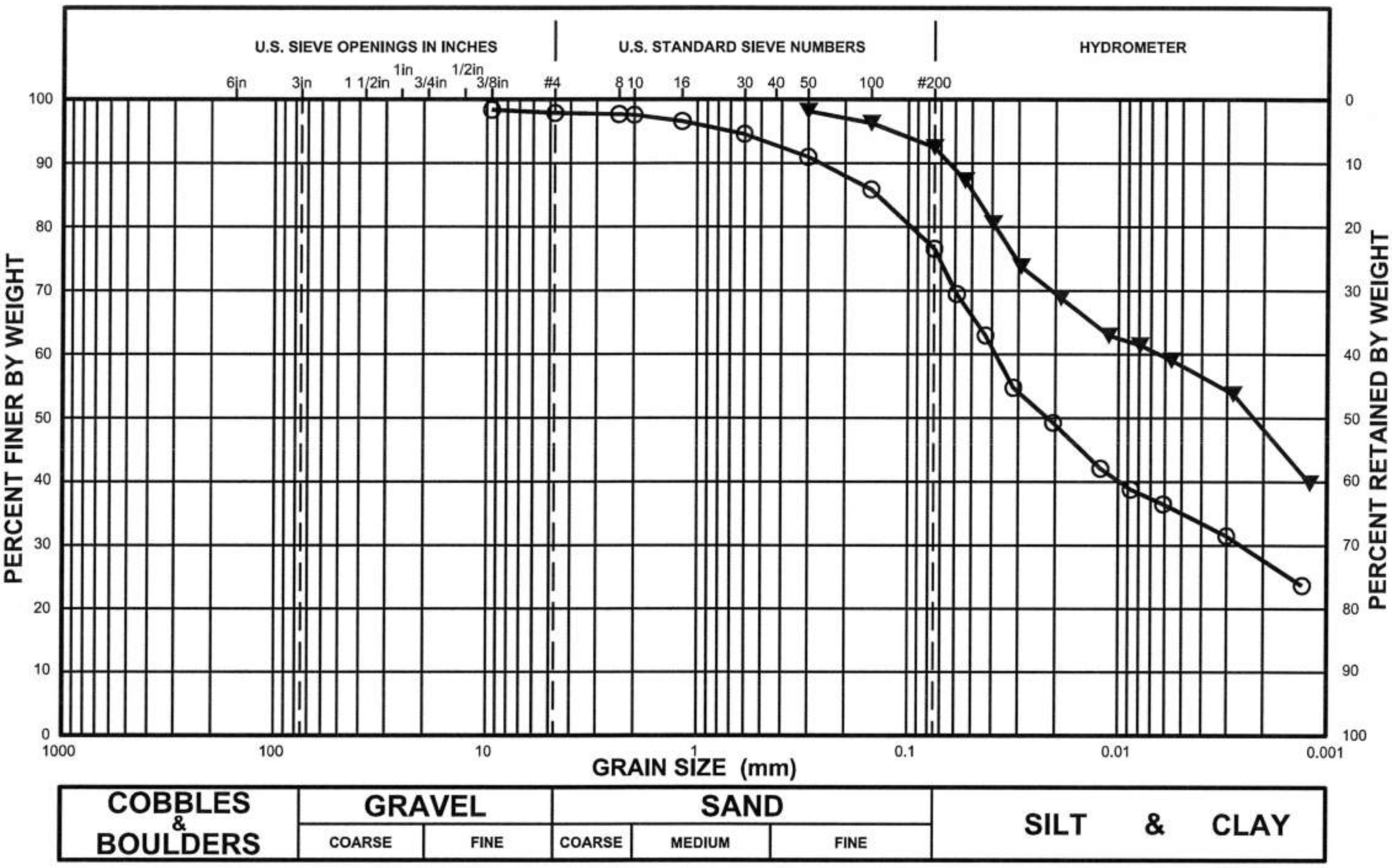
Depth = Sample Depth (ft) below ground surface
ST = Sample Type*
w = Initial Moisture Content (%)
DD = Initial Dry Unit Weight (pcf)
Max = Maximum Dry Unit Weight (pcf)
Opt = Optimum Moisture Content (%)
EI = Expansion Index
S = Degree of Saturation (%)

LL = Liquid Limit
PI = Plasticity Index
e = Void Ratio
n = Porosity (%)
WD = Initial Wet Unit Weight (pcf)
SD = Saturated Unit Weight (pcf)
BD = Bouyant (Submerged) Unit Weight (pcf) - Assuming water unit weight of 62.4 pcf

Consol = Consolidation Test Diagram (Plate No.)
Shear = Shear Test Diagram (Plate No.)

*** Sample Types: (U) = relatively Undisturbed; (S) = SPT; (B) = Bulk; (N) = Nuclear; (SC) = Sand Cone**

PARTICLE SIZE ANALYSIS

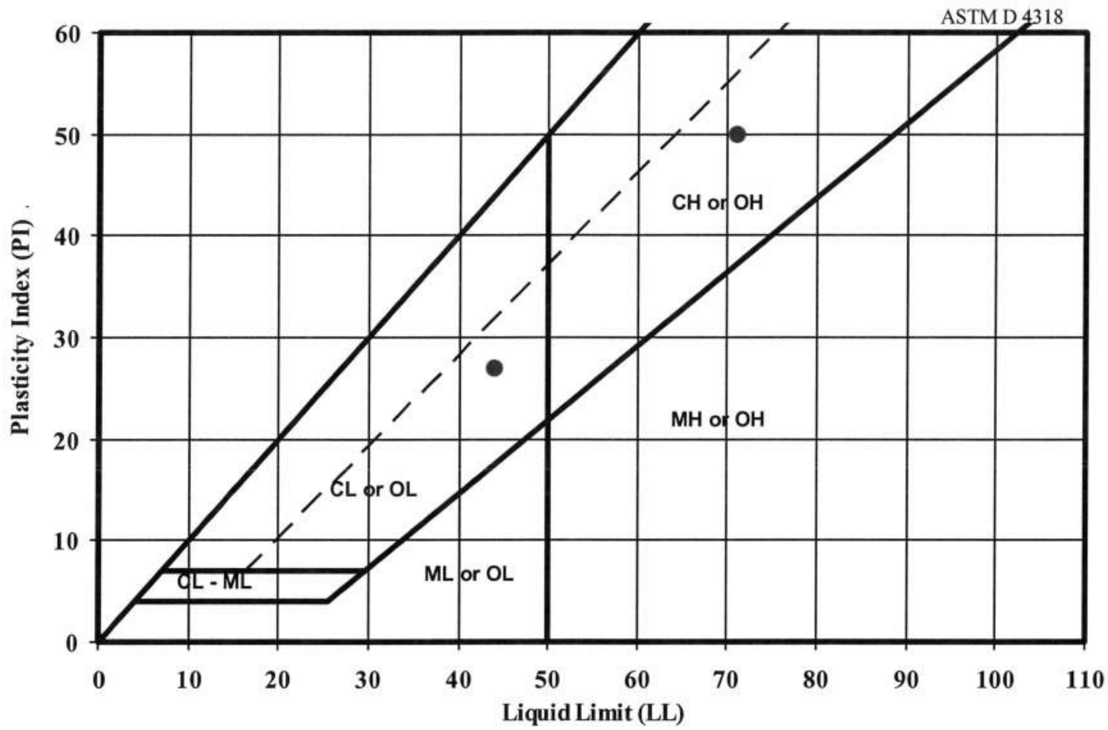


	SAMPLE	DESCRIPTION	%GRAVEL	%SAND	%FINES	D60	D30	D10	Cu	Cc	LL	PI
○	B1 @ 5'	Lean Clay with Sand (CL)	2.1	21	76.9	0.038	0.003	---	---	---	44	27
▼	B1 @ 20'	Fat Clay with Sand (CH)	---	8	92	0.006	---	---	---	---	71	50

8491.027

ATTERBERG LIMITS

PLASTICITY CHART

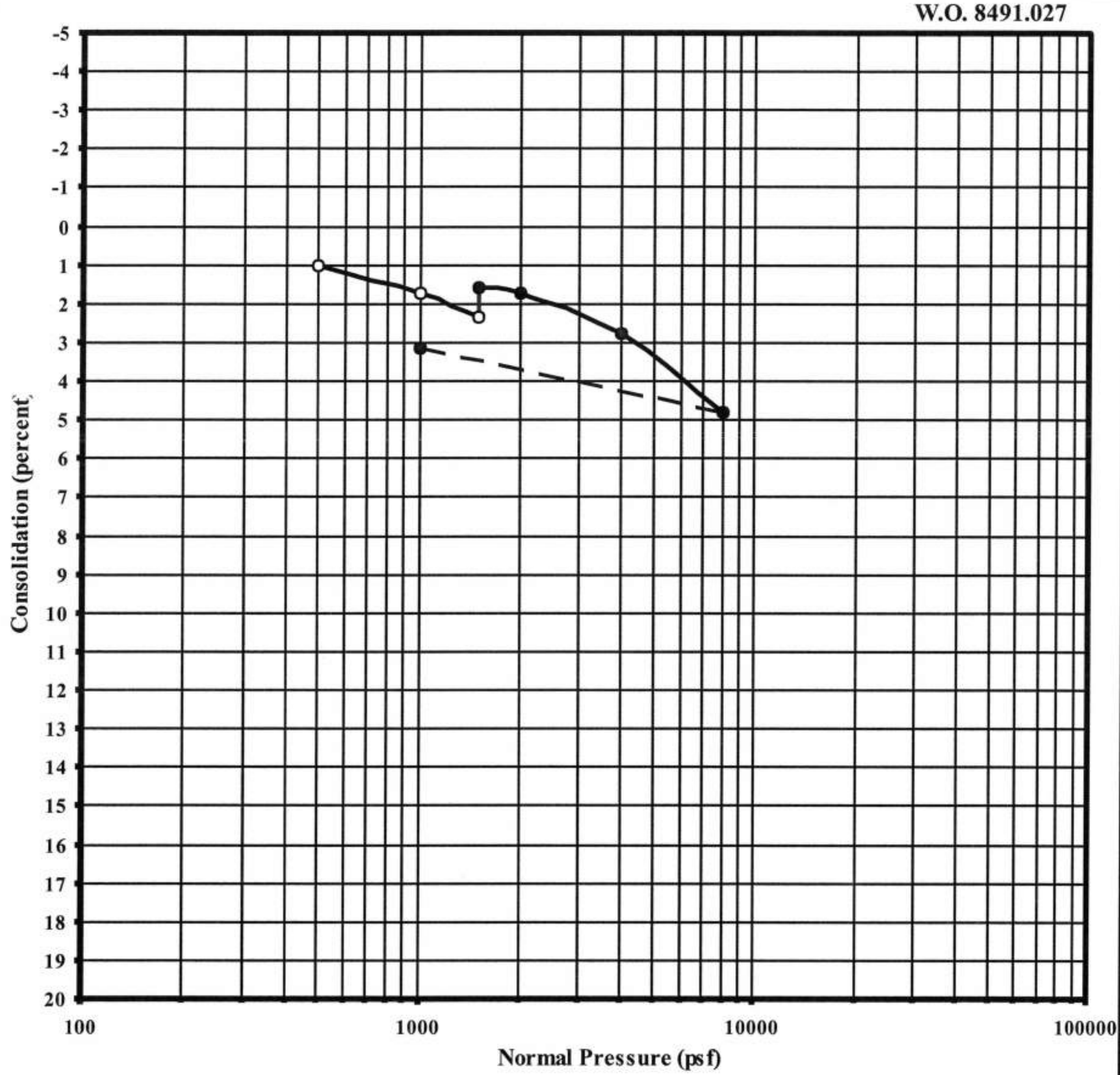


Excavation	Depth (ft)	Geology	Soil Description	LL	PI	% Clay (0.002mm	Fines Class	w	w/LL
B1	5	Qal	fat CLAY	44	27	28	CL		
B1	20	Qoal	fine sandy SILT	71	50	48	CH	34.1	0.48

LL = Liquid Limit, PI = Plasticity Index, NP = Non-Plastic , w = Field Moisture

CONSOLIDATION RESULTS

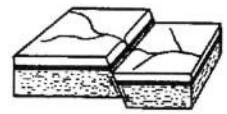
Undisturbed Sample



Sample Inundated At Normal Pressure of 1500 psf

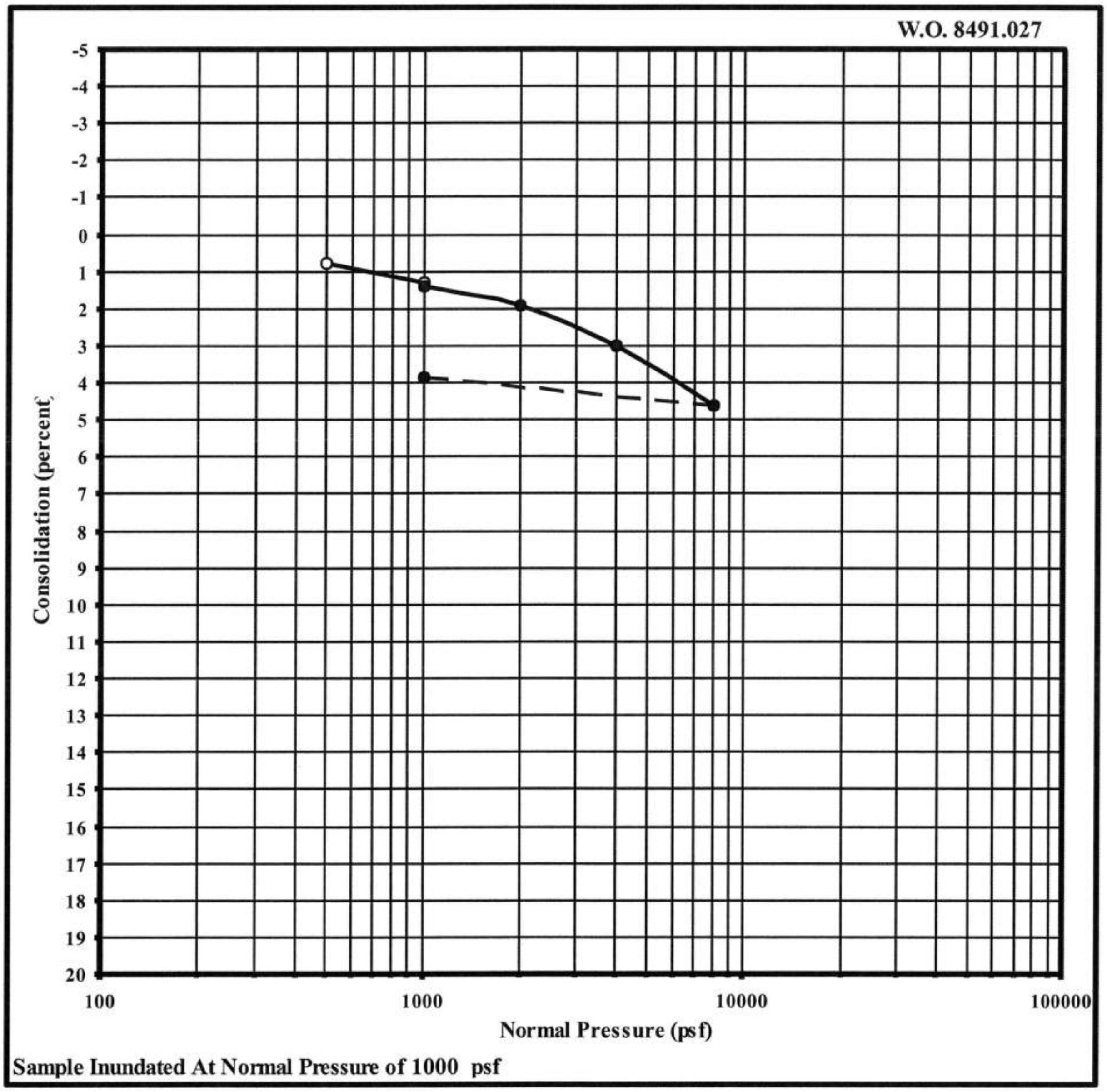
Sample Location: B1
Sample Depth: 15 ft.
Initial Moisture: 34 %
Init. Dry Density: 86.7 pcf

Geologic Unit: Older Alluvium
Material: lean CLAY



CONSOLIDATION RESULTS

Undisturbed Sample



Sample Location: B1

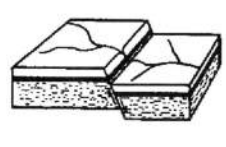
Sample Depth: 5 ft.

Initial Moisture: 19 %

Init. Dry Density: 107.4 pcf

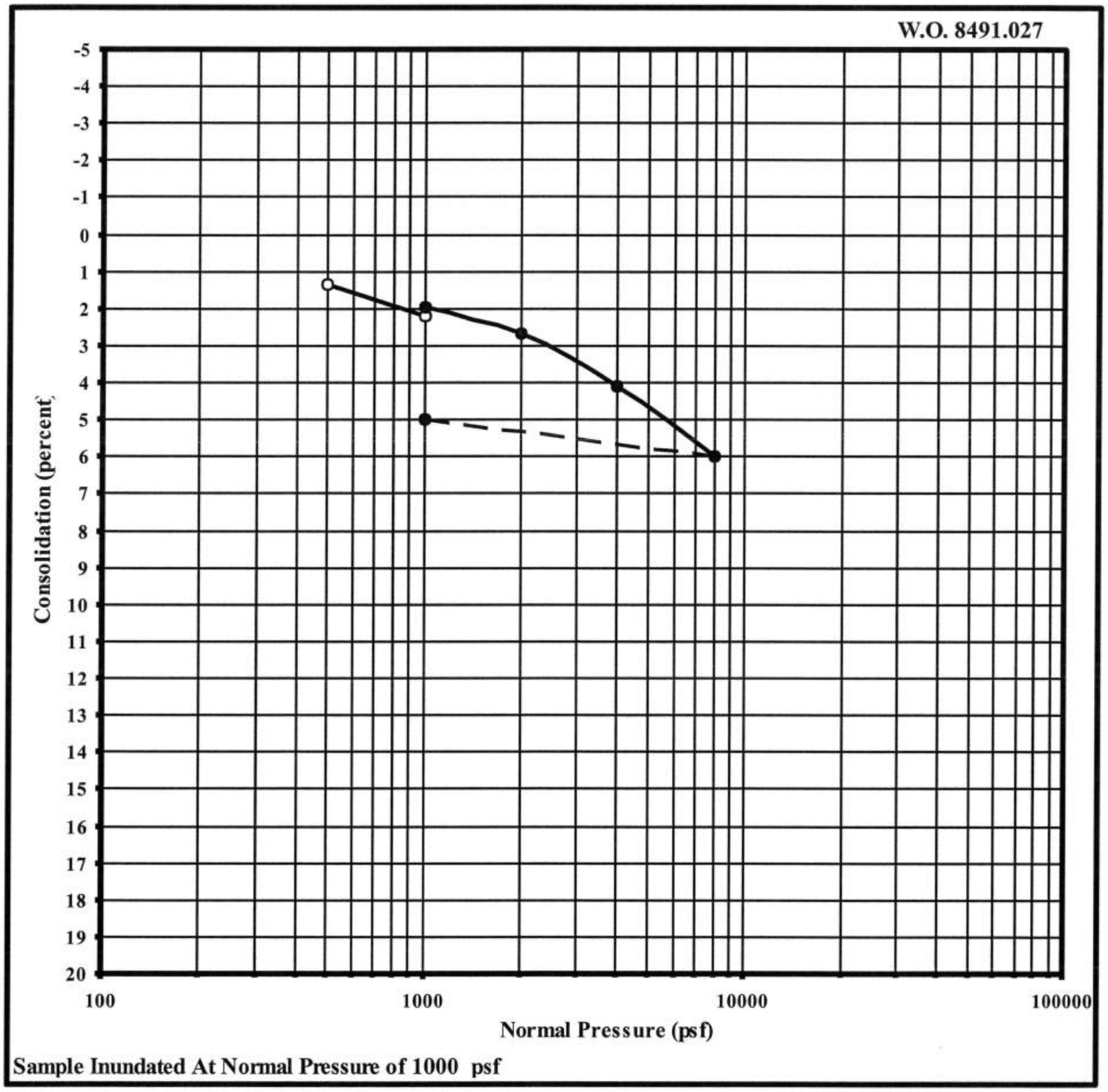
Geologic Unit: Alluvium

Material: lean CLAY



CONSOLIDATION RESULTS

Undisturbed Sample



Sample Location: B1

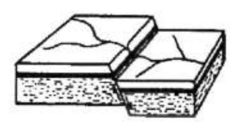
Sample Depth: 7.5 ft.

Initial Moisture: 19 %

Init. Dry Density: 107.9 pcf

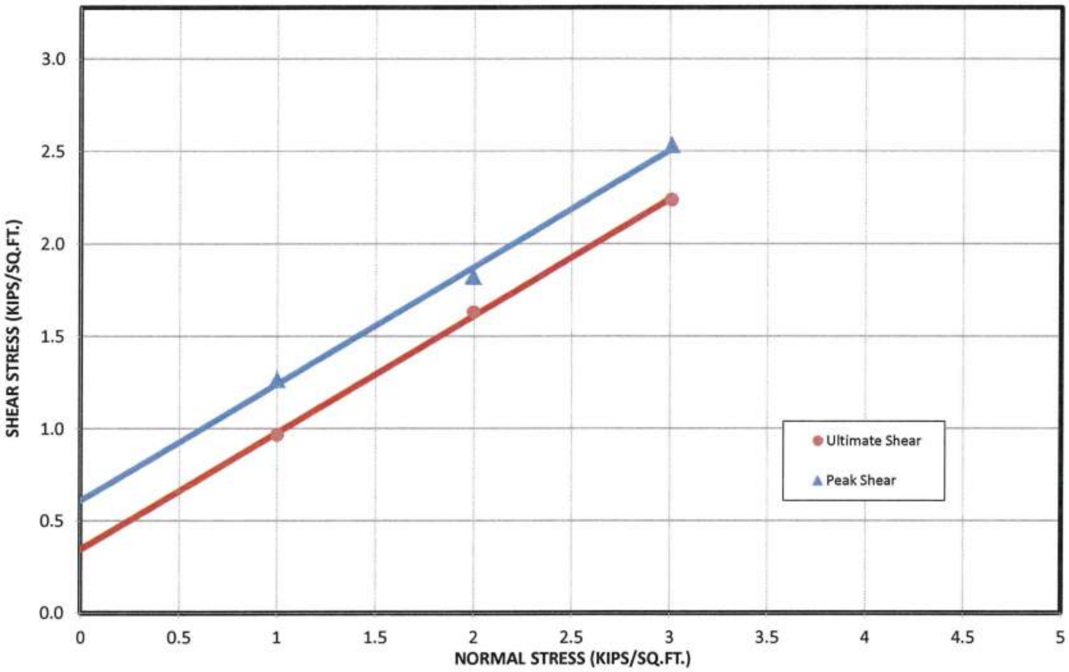
Geologic Unit: Alluvium

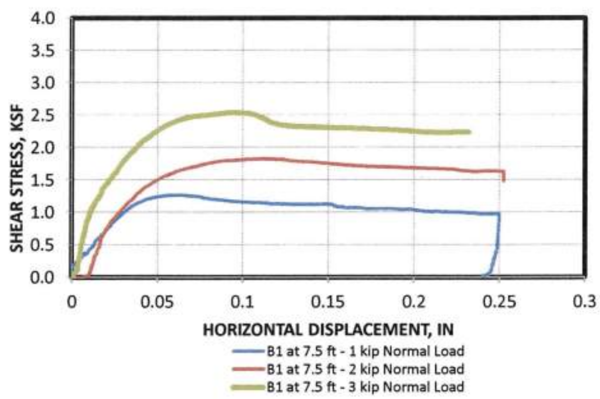
Material: sandy SILT



DIRECT SHEAR TEST RESULTS

Undisturbed Sample





TEST DATA:	#1	#2	#3
NORM. PRES. (KSF)	1.0	2.0	3.0
ULTIMATE			
SHEAR STRESS (KSF):	0.965	1.628	2.236
H.DISPL. (IN)	0.25	0.25	0.232
PEAK			
SHEAR STRESS (KSF):	1.264	1.824	2.532
H.DISPL. (IN)	0.06	0.11	0.09

PROJECT:	Management Center
W.O:	8491.027
EXCAVATION:	B1
DEPTH:	7.5 ft

	ULTIMATE	PEAK
COHESION (KSF):	0.350	0.600
PHI (DEG):	32	32

INITIAL DRY DENSITY (PCF):	107.9
INITIAL MOISTURE (% OF DD):	29.6
EST.VOID RATIO, e (preshear):	0.55

TEST FILES:

S:\GEOTEST\shears\8491.027\TEST259.DAT
S:\GEOTEST\shears\8491.027\TEST260.DAT
S:\GEOTEST\shears\8491.027\TEST261.DAT

a dba of
R & R Services
Corporation

Table 1 - Laboratory Tests on Soil Sample

Geolabs Westlake Village
Management Bldg. (CLU)
Your #8491.027, HDR Lab #19-0225LAB
22-Apr-19

Sample ID

			B1 @ 2.5-5'
Resistivity		**Units**	
as-received		ohm-cm	8,800
minimum		ohm-cm	1,200
pH			6.6
Electrical Conductivity		mS/cm	0.13
Chemical Analyses			
Cations			
calcium	Ca^{2+}	mg/kg	56
magnesium	Mg^{2+}	mg/kg	17
sodium	Na^{1+}	mg/kg	105
potassium	K^{1+}	mg/kg	8.9
Anions			
carbonate	CO_3^{2-}	mg/kg	12
bicarbonate	HCO_3^{1-}	mg/kg	317
fluoride	F^{1-}	mg/kg	7.0
chloride	Cl^{1-}	mg/kg	6.6
sulfate	SO_4^{2-}	mg/kg	17
phosphate	PO_4^{3-}	mg/kg	ND
Other Tests			
ammonium	NH_4^{1+}	mg/kg	ND
nitrate	NO_3^{1-}	mg/kg	4.4
sulfide	S^{2-}	qual	na
Redox		mV	na

Minimum resistivity per CTM 643, Chlorides per CTM 422, Sulfates per CTM 417

Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.

mg/kg = milligrams per kilogram (parts per million) of dry soil.

Redox = oxidation-reduction potential in millivolts

ND = not detected

na = not analyzed

Appendix C
Seismicity Analyses

W.O. 8491

April 29, 2019

OSHPD

CLU - New Management Building

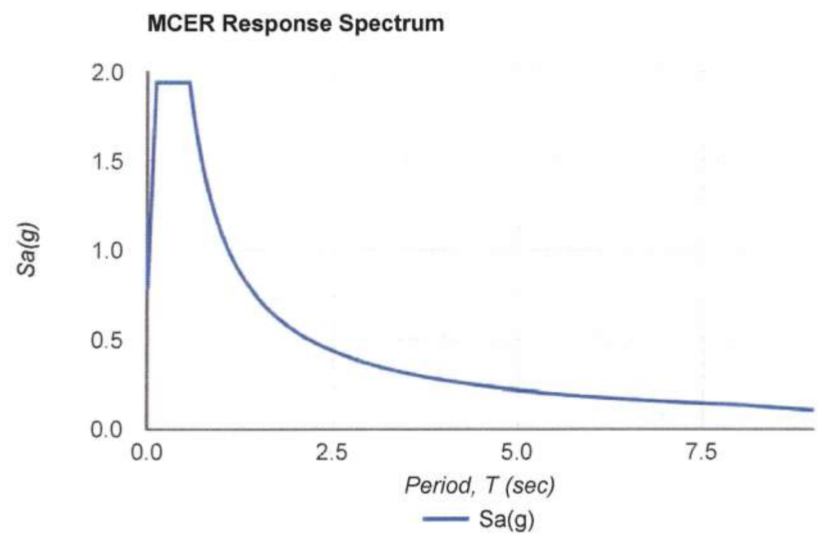
Latitude, Longitude: 34.22275295, -118.87854743

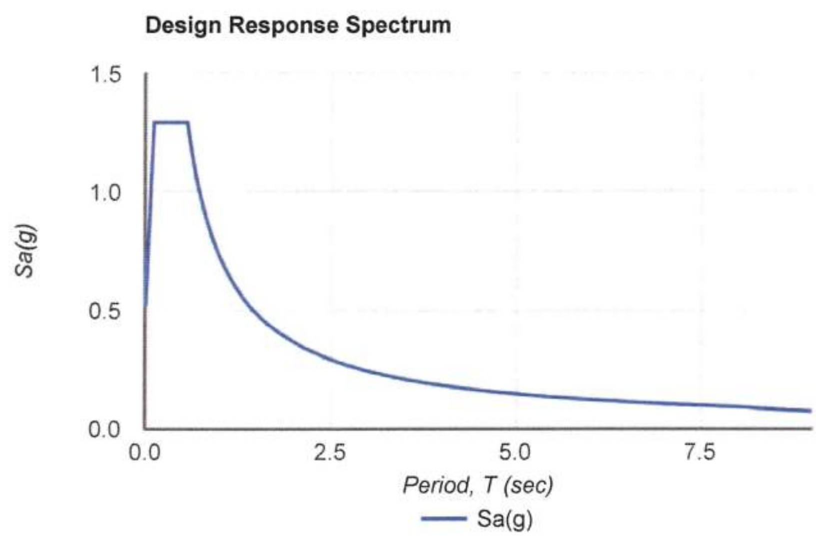
Date	4/29/2019, 1:14:41 PM
Design Code Reference Document	ASCE7-10
Risk Category	III
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.938	MCE_R ground motion. (for 0.2 second period)
S_1	0.721	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.938	Site-modified spectral acceleration value
S_{M1}	1.082	Site-modified spectral acceleration value
S_{DS}	1.292	Numeric seismic design value at 0.2 second SA
S_{D1}	0.721	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	D	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	1.5	Site amplification factor at 1.0 second
PGA	0.725	MCE_G peak ground acceleration
F_{PGA}	1	Site amplification factor at PGA
PGA_M	0.725	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	2.051	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.044	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.938	Factored deterministic acceleration value. (0.2 second)
S1RT	0.741	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.736	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.721	Factored deterministic acceleration value. (1.0 second)
PGAd	0.74	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	1.003	Mapped value of the risk coefficient at short periods

Type	Value	Description
C_{R1}	1.007	Mapped value of the risk coefficient at a period of 1 s





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Appendix D
Typical Details

W.O. 8491
April 29, 2019

RETAINING WALL
BACKDRAIN & BACKFILL

Native or Import soil - USCS Class SC, CL-ML or CL
EI < 20 or SE> 20 **

Upper 1 foot of backfill (level backslope) or backfill in sloping area should contain sufficient fines to provide adequate surficial slope stability and retard water infiltration.

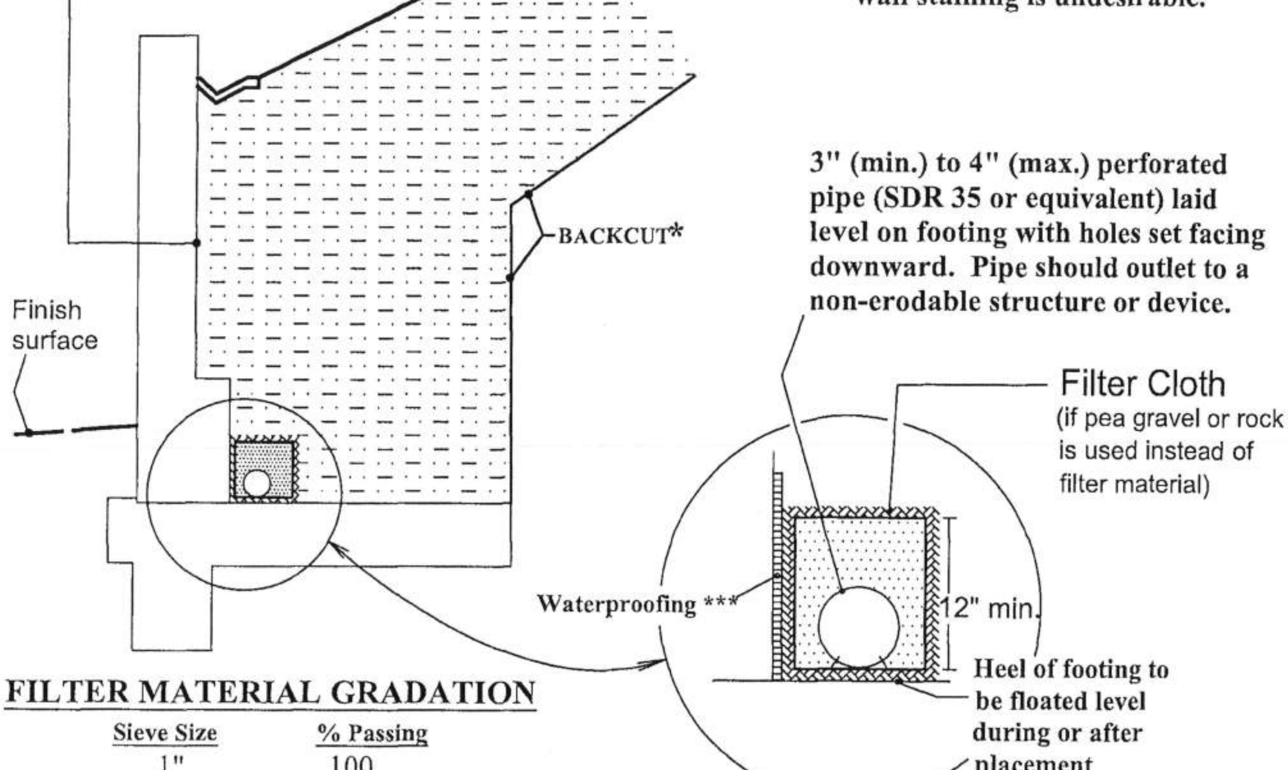
Backfill should be compacted to a minimum of 90% relative compaction.

FILTER MATERIAL (see gradation), pea gravel or rock - Geotextile should be used to separate pea gravel or rock from backcut and backfill.

*** All backcuts shall be in accordance with OSHA standards.**

**** EI 21-30 may be used if placed at 2% over optimum**

***** Where moisture penetration of wall or wall staining is undesirable.**



FILTER MATERIAL GRADATION

Sieve Size	% Passing
1"	100
3/4"	90-100
3/8"	40-100
#4	24-50
#8	15-35
#30	5-15
#50	0-7
#200	0-2

Geolabs – Westlake Village
GEOLOGY AND SOIL ENGINEERING

DATE 09/01/15 BY
SCALE N.T.S. W.O. 8191

PLATE **RW1**

Ret Wall Group 4.dwg

March 2012

APPENDIX F

Preliminary Hydrology Report

JENSEN
DESIGN & SURVEY, INC.
Delivering excellence through experience

1672 Donlon Street
Ventura, CA 93003
Local 805 654-6977
Fax 805 654-6979
www.jdscivil.com

CAL07.5405
May 20, 2019

City of Thousand Oaks, Public Works Department
Jim Taylor
2100 Thousand Oaks Blvd.
Thousand Oaks, CA 91362

Subject: Preliminary Hydrology for the Proposed Management Building
California Lutheran University

Dear Mr. Taylor,

Cal Lutheran University (CLU) is proposing to replace the existing Nygreen Hall, located south of Memorial Parkway and east of Pioneer Avenue in Thousand Oaks, CA, with a new School of Management building. The one-acre redevelopment includes construction of a ±15,000 SF management building and the reconfiguration of several plazas and pedestrian pathways around the building.

Hydrology

Currently, the site is 65% impervious and slopes in the northerly direction. A majority of runoff from the existing site is picked up by an existing storm drain system that runs northerly on the east and west sides of the existing building. This existing system drains through the curb north of the existing Nygreen Hall to Memorial Parkway. The redeveloped site will be 77% impervious and will follow existing drainage patterns. A majority of the runoff will flow into the proposed onsite stormdrain system. The storm drain system will convey runoff to one of the two proposed bioswales and ultimately, site runoff will drain through a curb drain onto Memorial Parkway.

The onsite stormdrain system will be sized for a 10-year storm event. Proposed flows for the site are calculated using the City of Thousand Oaks Storm Drain System Master Plan, dated October 2006. The project site falls within subarea boundary 838C, located within grids S13 and S14 of the City of Thousand Oaks master plan grid. The q10 and q100 for the subarea are 1.98 and 3.32 cfs/ac, respectively. Using the County multiplier of 0.882 for developed watersheds (taken from the County of Ventura Hydrology Manual, Appendix A, Exhibit 21: Design Storm Ratios), the q50 for the proposed site is 2.93 cfs/ac.

Proposed Runoff (from City of T.O. Master Drainage Plan):

q10	1.98	cfs/acre
q50	2.93	cfs/acre
q100	3.32	cfs/acre

Stormwater Treatment

The project is required to comply with the 2000 Ventura County Municipal Separate Storm Sewer System (MS4) permit (Order No. 00-108, NPDES Permit No. CAS004002). This permit requires that:

1. BMPs be sized to treat 10% of the proposed Q50 for the site (SQDF);
2. Or, BMPs be sized to treat a volume of 0.75" of rainfall across the site.

Two bioswales will be installed to treat runoff from the management building and surrounding hardscape (treatment areas A & B). The two bioswales will be located east and west of the proposed management building. The attached Stormwater Treatment Exhibit illustrates the respective bioswale locations and proposed drainage areas. Preliminary bioswale calculations are attached to this letter for reference.

There are three subareas along the northern edge of the proposed improvements that will bypass the treatment swales. Two are Subareas D & E, which do not require treatment as they are primarily landscaped and therefore permeable. Subarea C delineates impervious area that is infeasible to capture and treat prior to leaving the site due to existing constraints. The site slopes to Memorial Parkway, and eliminating hardscape between the proposed management building and Memorial Parkway would negatively affect the flow of pedestrian traffic. Infiltration is also infeasible due to the expansive clays at CLU. Subarea C makes up 21% of the overall proposed disturbed area, part of which covers the allowable 5% effective impermeable area (EIA).

Allowable EIA Calculations:

Subarea	Area (ac)	Area Percentage of Proposed Development	Treatment Method
A	0.28	28%	Bioswale
B	0.46	46%	Bioswale
C	0.21	21%	5% Allowable EIA plus 16% Untreated Area
D	0.02	2%	N/A – Landscaped Area
E	0.03	3%	N/A – Landscaped Area
Total	1.00	100%	

After runoff from the site drains to Memorial Parkway, it will flow west and enter the South Campus detention basin, prior to discharging into an offsite storm drain channel north of Olsen Road.

Detention

Stormwater detention currently provided on North Campus and South Campus accommodates the increase in runoff from the project site. The Master Plan of Drainage for CLU we prepared in 2004 identifies that detention is to be provided for the entire campus once redevelopment acreage exceeds 19.25 acres, which it now has. Detention for the entire campus requires 1.42 ac-ft of detention in addition to what is provided in the North Campus basin. This 1.42 ac-ft of detention is more than accommodated in the existing South Campus basin alone which provides 1.5 ac-ft. If and when this South Campus basin is removed for a future development, then additional detention will need to be provided elsewhere on campus. At this time there is no current plan for development within Storage Area B.

Conclusion

During final design, the site will be analyzed to ensure that the new school of management building is protected from a 100-year storm event. These preliminary calculations show that the proposed site will fulfill local agency requirements.

Sincerely,

Jensen Design & Survey, Inc.

Susanne M. Cooper, P.E.
Engineering Manager

REGISTERED PROFESSIONAL ENGINEER
SUSANNE M COOPER
No C060448
EXP 6/30/20
CIVIL
STATE OF CALIFORNIA
5-20 19

Attachments:

FlowMaster Bioswale Calculation Results
Treatment Area A, T-2: Grass Swale Filter Design Spreadsheet
Treatment Area B, T-2: Grass Swale Filter Design Spreadsheet
Stormwater Treatment Exhibit
City of Thousand Oaks Storm Drain System Master Plan – Hydrology Plate #2

CLU Management Building - Bioswal Calculations Report

Label	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (in)	Left Side Slope (ft/ft (H:V))	Right Side Slope (ft/ft (H:V))	Bottom Width (ft)	Discharge (ft^3/s)	Velocity (ft/s)
Treatment Area A	0.200	0.010	0.85	4.00	4.00	9.00	0.081	0.12
Treatment Area B	0.200	0.010	1.22	4.00	4.00	8.00	0.134	0.16

Worksheet for Treatment Area A

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.200	
Channel Slope	0.010	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	9.00	ft
Discharge	0.081	ft^3/s

Results

Normal Depth	0.85	in
Flow Area	0.65	ft^2
Wetted Perimeter	9.58	ft
Hydraulic Radius	0.82	in
Top Width	9.56	ft
Critical Depth	0.01	ft
Critical Slope	2.46069	ft/ft
Velocity	0.12	ft/s
Velocity Head	0.00	ft
Specific Energy	0.07	ft
Froude Number	0.08	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	in
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	in
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.85	in
Critical Depth	0.01	ft
Channel Slope	0.010	ft/ft

Worksheet for Treatment Area A

GVF Output Data

Critical Slope	2.46069	ft/ft

Worksheet for Treatment Area B

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.200	
Channel Slope	0.010	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	8.00	ft
Discharge	0.134	ft^3/s

Results

Normal Depth	1.22	in
Flow Area	0.85	ft^2
Wetted Perimeter	8.84	ft
Hydraulic Radius	1.16	in
Top Width	8.81	ft
Critical Depth	0.02	ft
Critical Slope	2.14023	ft/ft
Velocity	0.16	ft/s
Velocity Head	0.00	ft
Specific Energy	0.10	ft
Froude Number	0.09	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	in
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	in
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.22	in
Critical Depth	0.02	ft
Channel Slope	0.010	ft/ft

Worksheet for Treatment Area B

GVF Output Data

Critical Slope	2.14023	ft/ft

Design Procedure Form for T-2: Grass Swale Filter (GSWF)

Designer: Caitlin Evans
Company: Jensen Design & Survey, Inc
Date: Monday, May 20, 2019
Project: CLU Science Building
Location: TREATMENT AREA A

1.	Design Flow (Q50 = 0.81 cfs)	Qp,SQDF= 0.081 cfs
2.	Swale Geometry	
	a. Swale Bottom Width (b)	b= 9 ft
	b. Side Slope (Z)	Z - Left = 4 (Z:1) Z - Right = 4 (Z:1)
3.	Depth of Swale at SQDF (d) (2 ft max depth, Manning n = 0.20)	d= 0.9 inches
4.	Design Slope	
	a. s = 2percent maximum	s= 1 %
	b. No. of grade controls required	0
5.	Design flow Velocity (Manning n = 0.20)	V= 0.12 ft/sec
6.	Design Length L = (7 min)*(flow Velocity)*60	L= 50.40 feet (avail Len = 51 ft)
7.	Vegetation (describe)	
8.	Outflow Collection (check type used or described other)	___ Grate Inlet ___ Infiltration Trench ___ Underdrain X Other

Note:

Total available Length is 51 feet, which is greater than the required design length of 50.4 feet

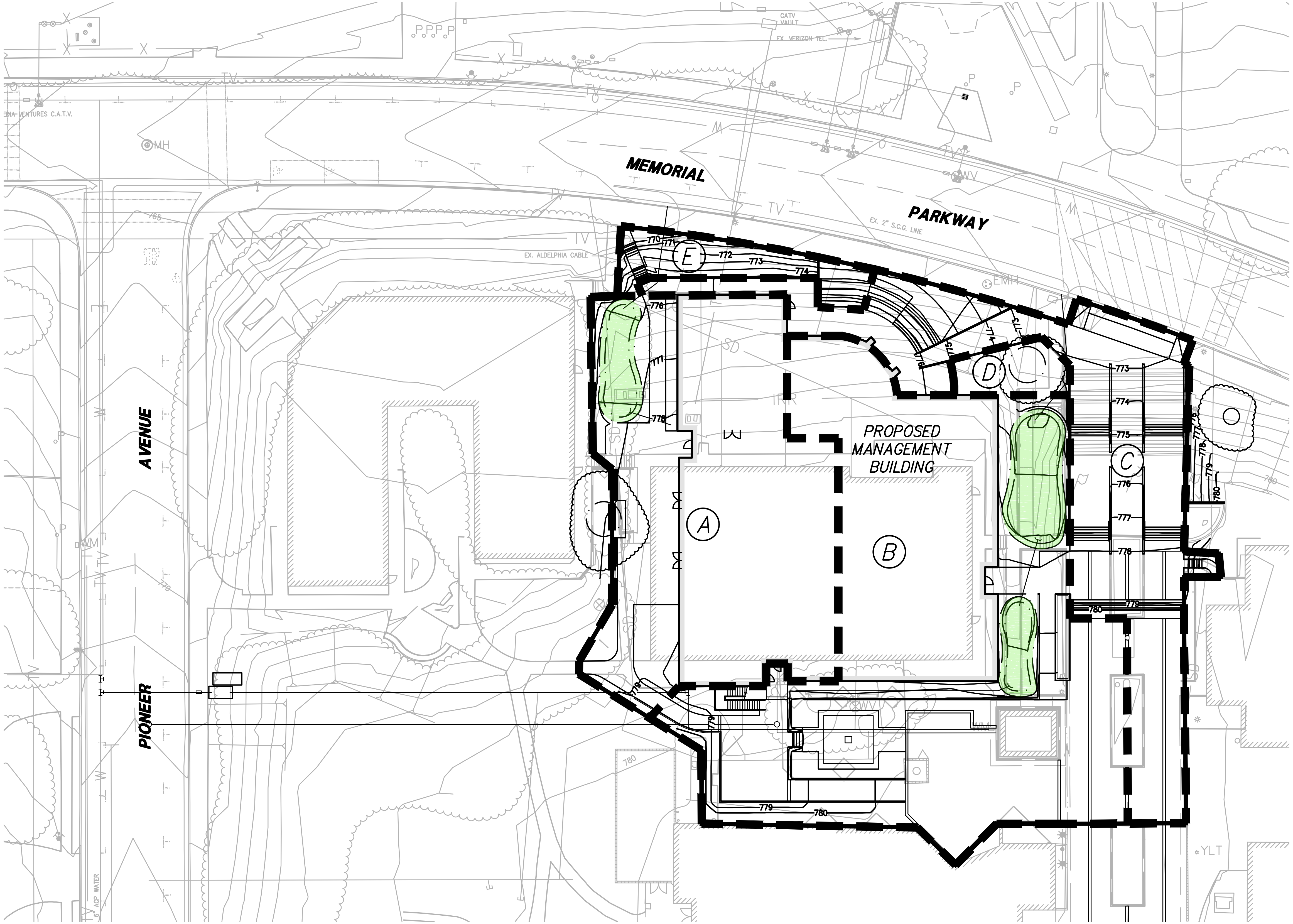
Design Procedure Form for T-2: Grass Swale Filter (GSWF)

Designer: Caitlin Evans
Company: Jensen Design & Survey, Inc
Date: Monday, May 20, 2019
Project: CLU Management Building
Location: TREATMENT AREA B

1. Design Flow (Q50 = 1.34 cfs)	Qp,SQDF= 0.134 cfs
2. Swale Geometry	
a. Swale Bottom Width (b)	b= 8 ft
b. Side Slope (Z)	Z - Left = 4 (Z:1) Z - Right = 4 (Z:1)
3. Depth of Swale at SQDF (d) (2 ft max depth, Manning n = 0.20)	d= 1.2 inches
4. Design Slope	
a. s = 2percent maximum	s= 1 %
b. No. of grade controls required	0
5. Design flow Velocity (Manning n = 0.20)	V= 0.16 ft/sec
6. Design Length L = (7 min)*(flow Velocity)*60	L= 67.20 feet (avail Len = 78 ft)
7. Vegetation (describe)	
8. Outflow Collection (check type used or described other)	___ Grate Inlet ___ Infiltration Trench ___ Underdrain X Other

Note:

Total available Length is 78 feet, which is greater than the required design length of 67.2 feet



NOTES:

- TREATMENT AREA BOUNDARY
- (X) TREATMENT AREA
- APPROXIMATE BIOSWALE LIMITS
- PROJECT BOUNDARY

20' 0' 40'

SCALE: 1"=40'

Treatment Area	Area (sf)	Area (ac)	Q50 (cfs)	SQDF (cfs)	Treatment Method
A	12000	0.28	0.81	0.08	Bioswale
B	19950	0.46	1.34	0.13	Bioswale
C	9300	0.21	0.63	0.06	N/A
D	760	0.02	0.05	0.01	N/A - Area is primarily landscape and does not require treatment
E	1450	0.03	0.10	0.01	N/A - Area is primarily landscape and does not require treatment
Total	43460	1.00	2.92		

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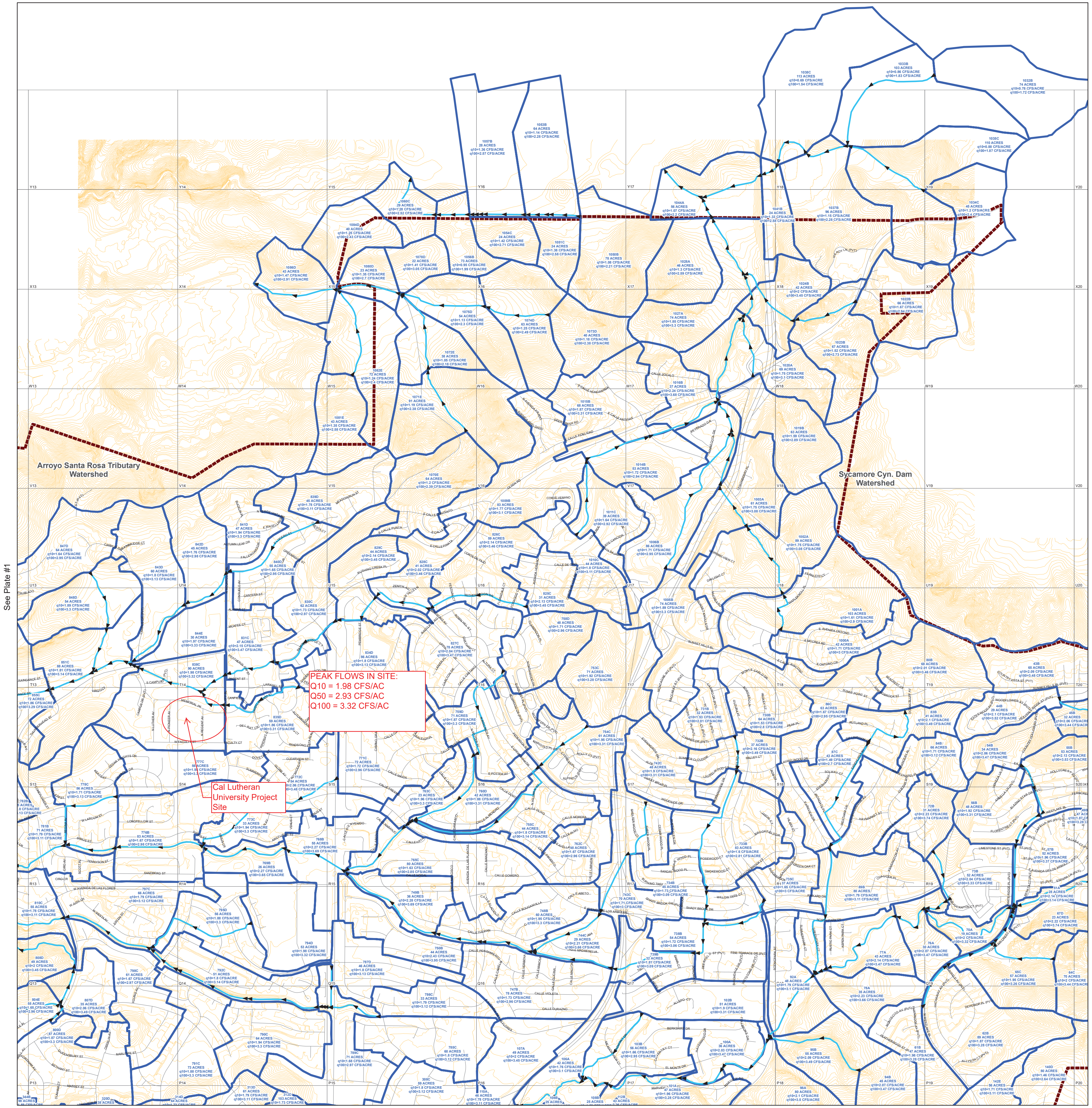
STORMWATER TREATMENT EXHIBIT

CLU MANAGEMENT BUILDING

SHEET 1 OF 1

May 10, 2019



City of Thousand Oaks
Storm Drain System Master Plan

Hydrology Plate #2

0 1,000 2,000 3,000 Feet

Legend

- Hydrology Links
- Subarea Boundaries
- Street Centerline
- City of Thousand Oaks Map Grid
- Thousand Oaks City Boundary
- 2001 - LIDAR 10 ft. Contours

October 2006