REPORT OF GEOTECHNICAL EXPLORATION
JKV COURTYARD E BUILDING
LEE'S SUMMIT, MISSOURI

Presented to:

John Knox Village

Prepared by:

Otto J. Kruger, Jr., P.E.

Kruger Technologies, Inc.
Lenexa, Kansas

KTI Project No. 223164G

September 25, 2023

KRUGER TECHNOLOGIES, INC.

GEOTECHNICAL ▪ ENVIRONMENTAL ▪ TESTING ▪ INSPECTION
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September 25, 2023

Mr. Eric Scott
Director of Operations and Development
John Knox Village
602 N.W Pryor Road
Lee's Summit, MO 64081

Re: KTI Project No. 223164G
JKV Courtyard E Building
Lee's Summit, Missouri

Dear Mr. Scott:

Kruger Technologies, Inc. (KTI) has completed the subsurface exploration and geotechnical report for the above referenced project. The purpose of this report is to describe the surface and subsurface conditions encountered at the site, analyze and evaluate this information, and prepare a summary of existing conditions, subsurface material characteristics, and to give site specific geotechnical design recommendations.

We thank you for the opportunity to work with John Knox Village. If you have any questions, please contact us at 913.498.1114.

Respectfully submitted,
Kruger Technologies, Inc.

Otto J. Kruger, Jr., P.E.
Missouri PE: 23994

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JKV COURTYARD E BUILDING
LEE'S SUMMIT, MISSOURI

AUTHORIZATION

The following table presents the authorization documentation history for the work performed and presented in this report by Kruger Technologies, Inc.

Project: JKV Courtyard E Building, Lee's Summit, Missouri		
Document:	**Date:**	**Requested/Provided:**
Request for Proposal	6-13-23	Mr. Eric Scott – Director of Operations and Development, JKV
KTI Proposal 23GT113	6-21-23	Dylan Kruger – Kruger Technologies, Inc.
Notice to Proceed	8-3-23	Mr. Eric Scott – Director of Operations and Development, JKV

PURPOSE AND SCOPE

The purpose of this investigation was to explore the surface and subsurface conditions present within the existing building site and provide recommendations regarding the following:

- Seismic Considerations
- Site Preparation and Engineered Fill
- Lateral Earth Pressure
- Shallow Foundations Bearing on Site Fill and or Native Soil
- Slab on Grade
- Surface Drainage
- Excavation Considerations

PROJECT DESCRIPTION

It is our understanding that the project consists of the demolition of the existing 31,000 square foot three-story structure at the project site and the design and construction of a new 72,119 square foot four-story wood framed structure in the vicinity of the existing building located at 515 NW Moore Street in Lee's Summit, Missouri. The new building will connect on three levels to the existing buildings "B" and "C". The design loads of the new structure were not provided at the time

of this report preparation. However, we assumed the new structure will be slab on grade construction with a finished floor close to the existing grade.

FIELD EXPLORATION PROCEDURES

Four (4) test borings for the four-story building area were completed on August 1, 2023. The borings were field selected by the client and field located by KTI. The boring locations are illustrated in the attached Boring Location Map. Depths indicated on the boring logs are referenced from the ground surface at the time of the exploration. A boring location map is attached.

The borings were drilled using an ATV CME-55 drill rig. Advancement of the test holes was accomplished using 4-inch continuous flight augers. Soil sampling was performed by hydraulically pushing thin wall steel (Shelby) tubes, by driving split-barrel samplers (Standard Penetration Test).

Site soils samples were visually and manually classified in general accordance with ASTM D 2488 by the drill crew chief as drilling progressed. The soil samples collected in the field were delivered to the laboratory for applicable testing and verification of the field classifications. The boring logs were created as the borings were advanced and the logs were supplemented with information from the laboratory tests to present data concerning the depth and classification of the various strata, water levels, and other pertinent information. The boring logs are attached in Appendix I.

During advancement of the borings, groundwater was not encountered at any test borings. It should be noted that water level determinations made in relatively impervious (clay) soils might not present a reliable indication of the actual water table. However, water level determinations made in relatively pervious (sand/silt) soils are considered an accurate indication of the water table at the time that those measurements are made. Fluctuations in the water table should be expected with changing seasons and annual differences.

LABORATORY TESTS

Laboratory tests were performed on the recovered soil samples to determine the engineering characteristics and for additional verification of the field classifications in accordance with ASTM D 2487. The results of these tests, including in-situ moisture, dry density, Atterberg and unconfined compressive strength tests are presented in Appendix II.

SITE CONDITIONS

The site address at the time of the exploration was 515 NW Moore Street in Lee's Summit, Missouri. At the time of investigation, the site housed the existing three-story structure. The area of the site around the existing building was relatively flat and level. Other than required infill after building demolition minimal cut/fill operations are expected.

GEOLOGY/SUBSURFACE CONDITIONS

Undocumented fills were encountered in the majority of the test borings at depths of approximately 3' to 5' below existing grade and displayed stiff to very stiff consistency. No information was provided regarding the placement of these fills and whether or not the fills were placed in controlled lifts or tested for compaction during placement. The site undocumented fill soils are comprised predominantly fat and lean clays. Below the fills, the undisturbed site soils were lean and fat clay. Highly weathered limestone bedrock materials and sample refusal were encountered at boring B-2 at 13.8 feet and at boring B-4 at 14.7

DESIGN CRITERIA AND RECOMMENDATIONS

Laboratory test results of the recovered samples showed the following characteristics that were used as criteria for determining the recommendations for bearing values and design data:

In-Situ Moisture	12.7 to 32.9 %
Dry Density	96.3 to 97.5 pcf
Liquid Limit	64 to 82 %
Plasticity Index	42 to 58 %
Unconfined Compressive Strength of Soils	4,406 to 6,747 psf

Seismic Considerations

Based on the International Building Code (IBC) Section 1613.1, the subsurface stratigraphy, and the use of a shallow foundation system bearing on existing site fill and or native soil, the general Site Class Definition for the project area is Site Class C.

Site Preparation and Engineered Fill

Areas to receive fill should be stripped of vegetation, topsoil, and any other deleterious materials. Any isolated areas of soft or deleterious materials encountered at subgrade elevation should be removed and replaced with engineered fill. The moisture content of the subgrade soils should be

appropriate to achieve the required compaction. Proper drainage of the construction areas should be provided to protect foundation and floor slab subgrade soils from the detrimental effects of weather conditions. Excavations should be kept as dry as possible. Any loose or soft materials that accumulate or develop on subgrade or bearing surfaces should be removed prior to the placement of concrete. Construction traffic, including foot traffic, should be minimized. Concrete should be placed in footing excavations as soon as possible after excavations are complete.

Trucks and other heavy construction vehicles should be restricted as much as possible from trafficking on the finished subgrade in the building to prevent unnecessary disturbances of subgrade soils. Excessive rutting or pumping of the subgrade could occur from construction traffic, particularly during periods of wet weather. If such disturbed areas develop, the subgrade may have to be excavated and replaced with properly compacted fill.

Supplemental engineered fill should be placed in uniform horizontal lifts, with loose thicknesses not exceeding eight inches. The thickness must be appropriate for the method of compaction and the type of equipment used. The geotechnical engineer should approve any off-site material proposed for use as fill. Engineered fill should be compacted to a minimum of 95 percent of maximum density as determined by ASTM D698 (standard Proctor test) at a moisture content between 0 and 4 percent above optimum moisture for high plasticity clay material and from -2 to +2 from optimum moisture content for low plasticity clays. Most of the site soils encountered during the exploration are suitable for reuse as engineered fill except below the slab on grade (see Slab on Grade section for more details.) Any off-site soil to be used as engineered fill should be approved prior to use.

The fill should be benched in any sloped areas greater than one vertical to five horizontal in order to maintain relatively horizontal lifts. The benching should be placed at not less than 12-inch rises over those areas where it is required as the work is brought up in layers.

Building Pad – It is recommended that fill consist of cleaner soil materials with a maximum particle size of 3 inches. The use of material larger than 3 inches may cause differential settlement below the building slab. Acceptable fill material for below the top 18 inches of the building pad may be GW, GC, GM, SW, SM, SC, ML, MH, CL and CH. The soils encountered on site below the topsoil are classified as acceptable fill material for this application. Material used in the top 18 inches of the building pad should be a low volume change (LVC) material. Acceptable LVC material is any

soil type that has a Liquid Limit (LL) of less than 45 and a Plasticity Index (PI) of less than 25. Crushed rock or sand materials are also considered to be LVC material**. The soils encountered on site do not meet the requirements for LVC material.**

Lateral Earth Pressures

The following K values may be used for the determination of lateral soil resistance for retaining structures and below grade walls.

Site Soils (Estimated ϕ of 20°)

K_a = 0.49
K_p = 2.04
K_o = 0.66
Wet density of in place soil, average (γ) = 125 pcf

Granular Backfill (Estimated ϕ of 35°)

K_a = 0.27
K_p = 3.69
K_o = 0.43
Wet density of in-place crushed rock, average (γ) = 135 pcf

These design values do not include the effects of hydrostatic water or surface surcharges.

Shallow Foundations Bearing on Site Fill and or Native Soil

Provided that infill activities after demolition of the existing structure follow the Site Preparation and Engineered Fill section of this report, future engineered fill and undisturbed soils present at approximate footing bearing elevations should exhibit a net allowable bearing capacity of 2,500 pounds per square foot (psf) for both continuous footings and for rectangular footings. However, since much of the site was found to have undocumented fills, KTI recommends observation of the bearing surfaces at the time of footing excavations to verify adequate bearing conditions. This bearing value is based on a minimum factor of safety of three against actual shear failure. Anticipated settlements for these bearing capacities are 0.5-0.75 inches of total settlement, with a likely differential settlement of 0.5 inches over a horizontal distance of 30 feet. The minimum frost depth for this region is 36 inches. We recommend that the minimum column or isolated footing width be 30 inches and the minimum continuous footing width be 18 inches.

Slab on Grade

For slab on grade subgrade, it is recommended that the top 18 inches of subgrade directly below the slab (including the capillary moisture barrier) be a low swell potential material or low volume change material (LVC). Acceptable LVC material is any soil type that has a Liquid Limit (LL) less than 45 and a Plasticity Index (PI) less than 25. Crushed rock or sandy, silty lean clay materials are also considered to be LVC material. **Based on the test results, the majority of site soils from 1 foot to 3 feet below the existing grade did not meet the requirement for LVC material and should not be used directly below the slab.**

Movement between slabs on grade and walls may occur. To minimize the effects of this movement, we recommend that slip joints be incorporated between all slabs and walls. All slabs should contain crack control and construction joints, which are formed on 15 to 25-foot centers, each way, or as designed by the project structural engineer. A capillary moisture barrier should be placed under the slabs. This barrier should be a minimum of a 6-inch thick layer of clean granular material extending to the limits of the foundation walls. Should additional moisture protection be desired, it should be a minimum of 6-mil polyethylene sheeting placed between the slab and the base course.

For the purpose of slab design, a modulus of subgrade reaction (k) of 100-pounds/cubic inch is suggested. This value is based on a subgrade consisting of well-compacted, plastic clay fill.

Surface Drainage

In order to reduce the problems related to water infiltration, it is recommended that the final grade around the structure perimeters have a positive slope extending at least six feet away from the structure. Backfill of soils around the foundation should be compacted at a minimum of 95 percent of maximum dry density at moisture content between optimum and four percent above optimum in accordance with ASTM D 698.

Excavation Considerations

We believe that the project soils are Type B as classified in the OSHA Excavation Standard Handbook 29 CFR Parts 1926.650 through 1926.652. Type B soils are characterized by cohesive soils above the water table with unconfined compressive strengths greater than 0.5 tons per square foot (tsf) but less than 1.5 tsf. Type B soils include any fill soils meeting or exceeding the above criteria, as well as undisturbed soils with unconfined compressive strengths of >1.5 tsf

which are subject to vibration from traffic. Temporary excavation slopes for Type B soils can be one horizontal to one vertical with a maximum excavation depth of 20 feet.

Excavations deeper than 20 feet may require the use of supplemental shoring and will require the preparation of an excavation design prepared by a registered professional engineer. Competent bedrock material may generally be cut vertically.

REMARKS

It is recommended that the geotechnical engineer be retained to review the plans and specifications for the project so that an evaluation and comments can be provided regarding the proper incorporation of information from this geotechnical report into the final construction documents. We further recommend that the geotechnical engineer be retained during construction phases for earthwork and foundations to provide observation and testing to aid in determining that design intent has been accomplished.

The findings in this report are based on data acquired to date and are assumed to be representative of conditions at locations between borings. Due to the fact that the area at the borings is very small relative to the overall site, and for other reasons, we make no statement warranting the conditions below our borings or at other locations throughout the site. In addition, we do not warrant that the general strata logged at the borings are necessarily typical of the remaining areas of the site.

BORING LOCATION MAP

Boring Location Diagram
JKV Courtyard E Building
Lee's Summit, Missouri

KRUGER TECHNOLOGIES, INC.

Drawn: TMA	**Date:** 9/18/23	**KTI Project No**. 223164G

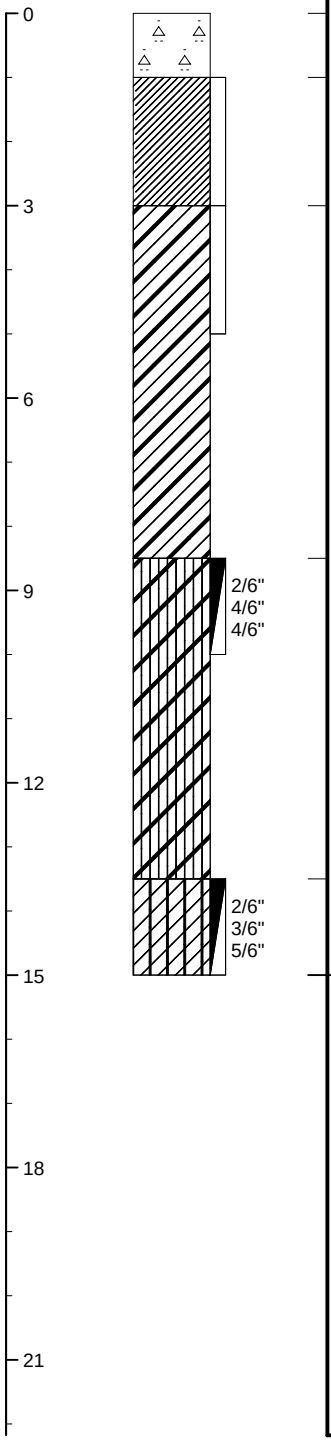
APPENDIX I

Boring Logs

LOG OF TEST BORING
BORING B-1

PROJECT: JKV Courtyard E Building
CLIENT: John Knox Village
PROJECT NO.: 223164G **START:** 9/1/23
BORING LOCATION: See Boring Location Plan
METHOD OF DRILLING: 4" Continuous Flight Augers
DEPTH TO - water None **caving**

DATE: 9/25/2023
ELEVATION:
FINISH: 9/1/23
LOGGER: JC
DATE CHECKED:



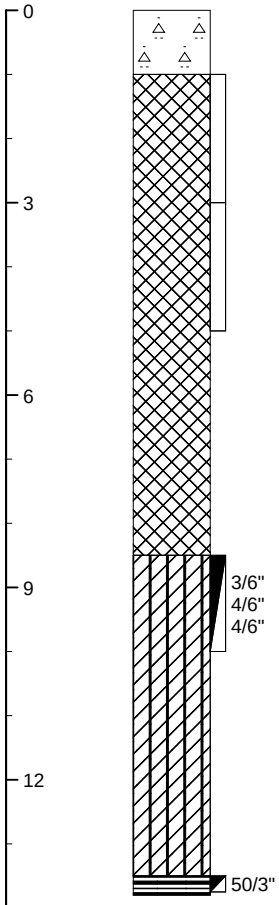
ELEVATION/ DEPTH	USCS	Description	Sample # & Type	Density pcf	Moist-ure, %	Qu, psf
0	T	**Topsoil**				
	CH	**Fill, fat clay, stiff, dark brown to black, moist**	1, ST			
3		**Lean to fat clay, stiff, brown, moist**	2, ST	96.3	17.9	4406
6	CL-CH					
9		**Silty lean clay, medium stiff, moist**	1, SS		26.3	
	CL-ML					
12						
	CL	**Lean clay, medium stiff, tan, moist**	2, SS		28.1	
15		**Drilling discontinued at 15.0 feet**				
18						
21						

Notes:

LOG OF TEST BORING
BORING B-2

PROJECT: JKV Courtyard E Building
CLIENT: John Knox Village
PROJECT NO.: 223164G **START:** 9/1/23
BORING LOCATION: See Boring Location Plan
METHOD OF DRILLING: 4" Continuous Flight Augers
DEPTH TO - water None **caving**

DATE: 9/25/2023
ELEVATION:
FINISH: 9/1/23
LOGGER: JC
DATE CHECKED:



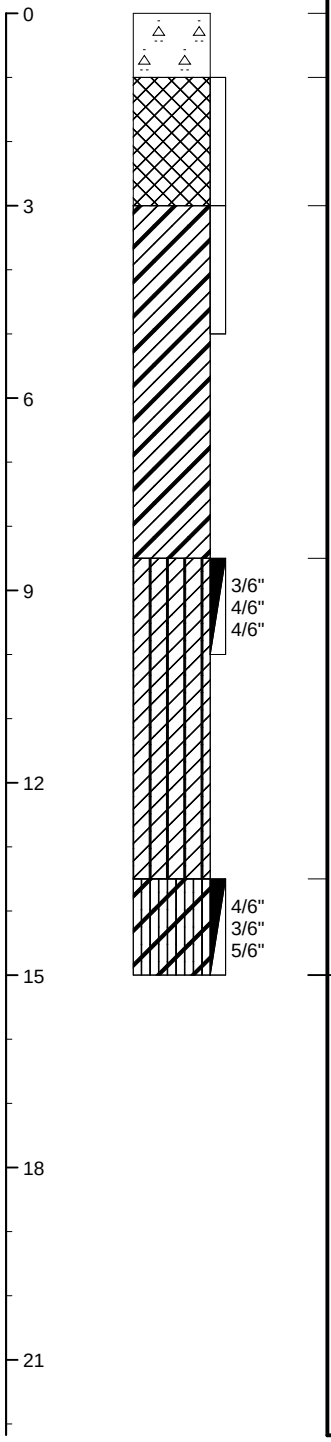
ELEVATION/ DEPTH	USCS	Description	Sample # & Type	Density pcf	Moist-ure, %	Qu, psf
	T	**Topsoil**				
	FILL	**Fill, fat clay, stiff, dark brown to black, moist**	1, ST			
		Fill, lean to fat clay, very stiff, brown to black, moist	2, ST	97.5	18.4	6747
	FILL					
	CL	**Lean clay, medium stiff, dark brown, moist**	1, SS		26.2	
	W	**Weathered limestone, hard**	2, SS		14.9	
		Drilling discontinued at sample refusal at 13.8 feet				

Notes:

LOG OF TEST BORING
BORING B-3

PROJECT: JKV Courtyard E Building
CLIENT: John Knox Village
PROJECT NO.: 223164G **START:** 9/1/23
BORING LOCATION: See Boring Location Plan
METHOD OF DRILLING: 4" Continuous Flight Augers
DEPTH TO - water None **caving**

DATE: 9/25/2023
ELEVATION:
FINISH: 9/1/23
LOGGER: JC
DATE CHECKED:



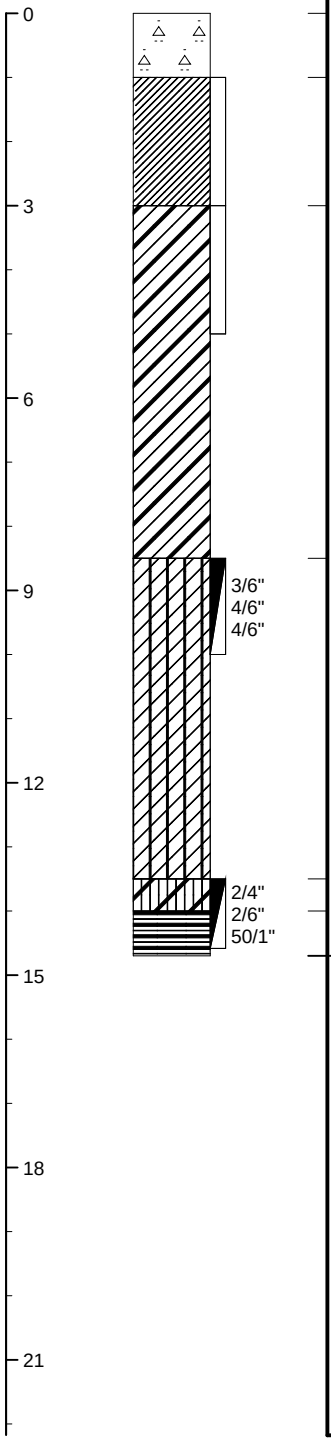
ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Sample # & Type	Density pcf	Moist-ure, %	Qu, psf
		T	**Topsoil**				
		FILL	**Fill, fat clay, stiff, dark brown to black, moist**	1, ST		12.7	
		CL-CH	**Lean to fat clay, very stiff, brown, moist**	2, ST			
		CL	**Lean clay, medium stiff, tan, moist**	1, SS		28.5	
		CL-ML	**Silty lean clay, medium stiff, brown, moist**	2, SS		27.3	
			Drilling discontinued at 15.0 feet				

Notes:

LOG OF TEST BORING
BORING B-4

PROJECT: JKV Courtyard E Building
CLIENT: John Knox Village
PROJECT NO.: 223164G **START:** 9/1/23
BORING LOCATION: See Boring Location Plan
METHOD OF DRILLING: 4" Continuous Flight Augers
DEPTH TO - water None **caving**

DATE: 9/25/2023
ELEVATION:
FINISH: 9/1/23
LOGGER: JC
DATE CHECKED:



ELEVATION/ DEPTH	USCS	Description	Sample # & Type	Density pcf	Moist-ure, %	Qu, psf
	T	**Topsoil**				
	CH	**Fill, fat clay, stiff, dark brown to black, moist**	1, ST			
		Lean to fat clay, very stiff, brown, moist	2, ST		21.3	
	CL-CH					
		Lean clay, medium stiff, light grayish brown, moist	1, SS		23.6	
	CL					
	CL-ML	**Silty lean clay, brown, wet**	2, SS		32.9	
	W	**Weathered limestone, hard**				
		Drilling discontinued at sample refusal at 14.7 feet				

Notes:

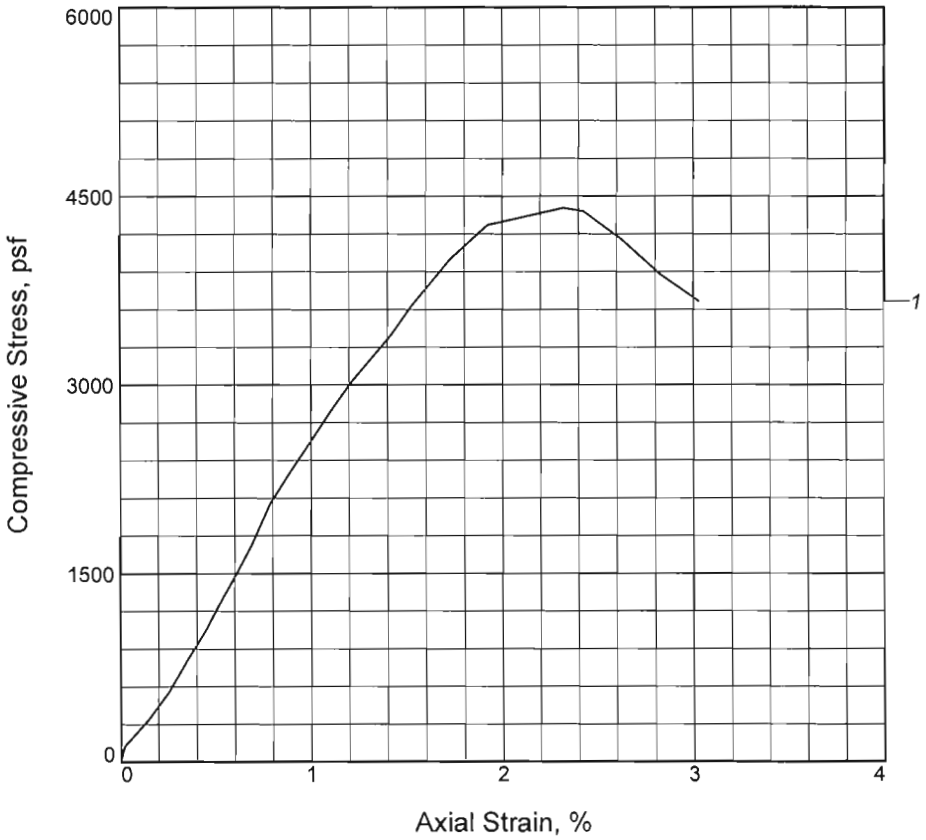
APPENDIX II

Laboratory Results

SUMMARY OF LABORATORY TEST RESULTS UNDISTURBED SAMPLE

Boring	Depth (Ft)	Sample No./Type	Natural Moisture %	Natural Dry Density (pcf)	Unconfined Compressive Strength (psf)	Atterberg Limits		Soil Type
						Liquid Limit %	Plasticity Index %	
B-1	3.0-5.0	ST-2	17.9	96.3	4406	64	42	CH
B-1	8.5-10.0	SS-1	26.3					
B-1	13.5-15.0	SS-2	28.1					
B-2	3.0-5.0	ST-2	18.4	97.5	6747			
B-2	8.5-10.0	SS-1	26.2					
B-2	13.5-15.0	SS-2	14.9					
B-3	1.0-3.0	ST-1	12.7					
B-3	8.5-10.0	SS-1	28.5					
B-3	8.5-10.0	SS-1	27.3					
B-4	1.0-3.0	ST-1	21.3			82	58	CH
B-4	8.5-10.0	SS-1	23.6					
B-4	13.5-15.0	SS-2	32.9					

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	4406			
Undrained shear strength, psf	2203			
Failure strain, %	2.3			
Strain rate, in./min.	0.050			
Water content, %	17.9			
Wet density, pcf	113.5			
Dry density, pcf	96.3			
Saturation, %	63.7			
Void ratio	0.7635			
Specimen diameter, in.	2.84			
Specimen height, in.	5.89			
Height/diameter ratio	2.07			

Description: Lean to fat clay, stiff, brown, moist

LL =	**PL =**	**PI =**	**Assumed GS=** 2.72	**Type:** ST

Project No.: 223164G
Date Sampled: 9/1/23
Remarks:

Client: John Knox Village

Project: JKV Courtyard E Building

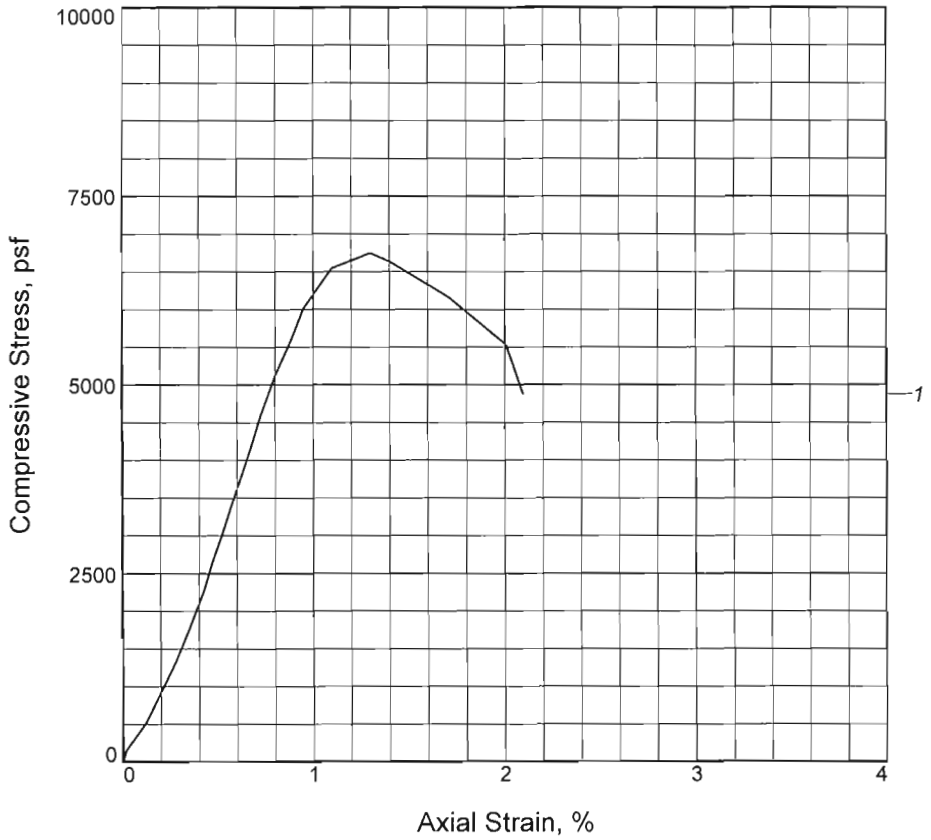
Source of Sample: B-1 **Depth:** 3
Sample Number: 2

Figure _____

[redacted]KTI[redacted]

Tested By: TA **Checked By:** OJK

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, psf	6747			
Undrained shear strength, psf	3373			
Failure strain, %	1.3			
Strain rate, in./min.	0.050			
Water content, %	18.4			
Wet density, pcf	115.5			
Dry density, pcf	97.5			
Saturation, %	67.7			
Void ratio	0.7409			
Specimen diameter, in.	2.86			
Specimen height, in.	5.87			
Height/diameter ratio	2.05			

Description: Fill, lean to fat clay, very stiff, brown to black, moist

LL =	**PL =**	**PI =**	**Assumed GS=** 2.72	**Type:** ST

Project No.: 223164G
Date Sampled: 9/1/23
Remarks:

Client: John Knox Village

Project: JKV Courtyard E Building

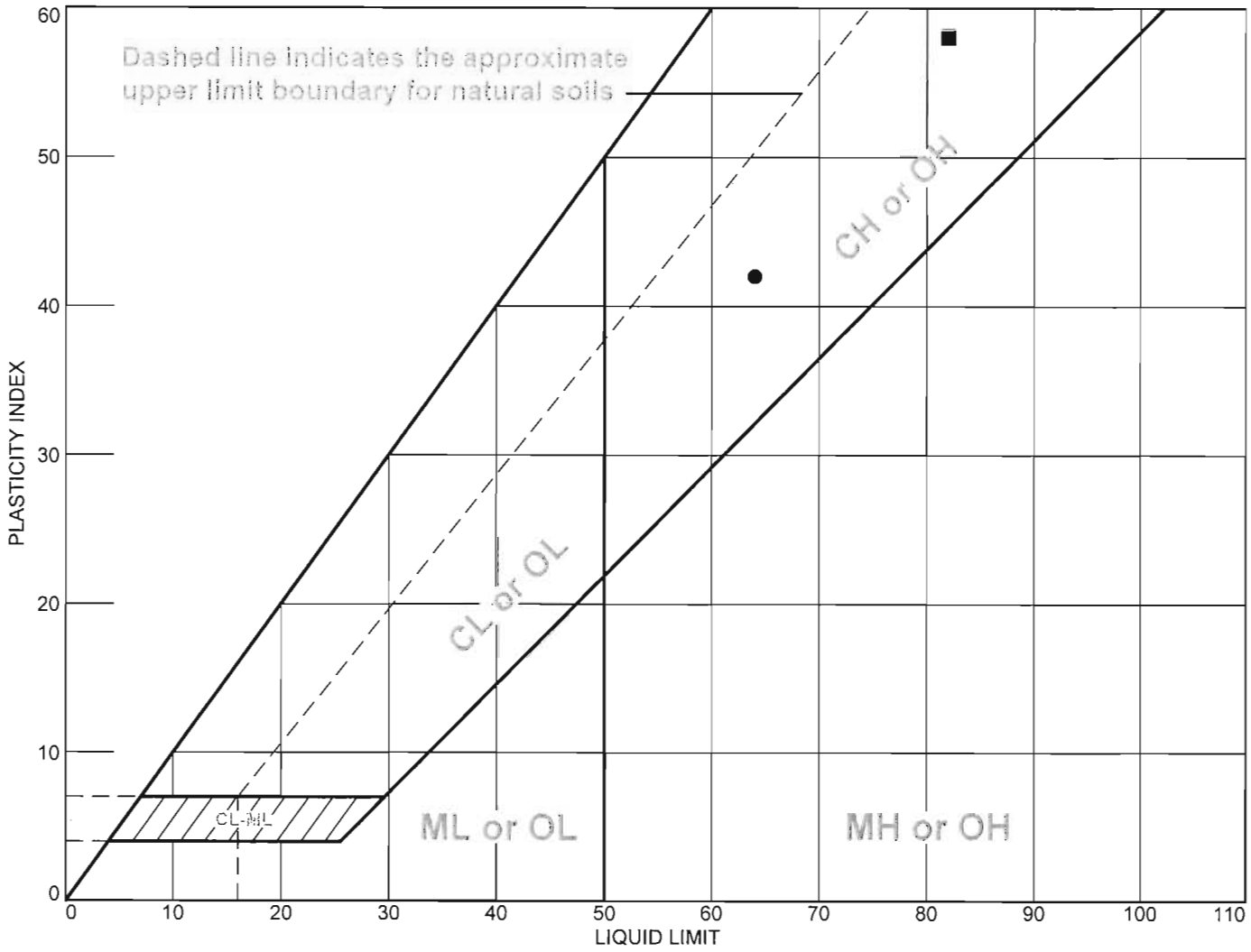
Source of Sample: B-2 **Depth:** 3
Sample Number: 2

[redacted]KTI[redacted]

Figure _____

Tested By: TMA **Checked By:** OJK

LIQUID AND PLASTIC LIMITS TEST REPORT ASTM D 4318



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Fill, fat clay, stiff, dark brown to black, moist	64	22	42			CH
■	Fill, fat clay, stiff, dark brown to black, moist	82	24	58			CH

Project No. 223164G **Client:** John Knox Village

Project: JKV Courtyard E Building

● **Source of Sample:** B-1 **Depth:** 1 **Sample Number:** 1

■ **Source of Sample:** B-4 **Depth:** 1 **Sample Number:** 1

Remarks:

[redacted]KTI[redacted]

Figure

GLOSSARY OF GEOTECHNICAL TERMS

ALLUVIUM	Sediments deposited by streams, including riverbeds and floodplains.
ARGILLACEOUS	Rocks composed of or having a notable portion of fine silt and/or clay in their composition.
ATTERBERG LIMITS	Water contents, in percentage of dry weight of soil, that correspond to the boundaries between the states of consistency, i.e. the boundary between the liquid and plastic states (liquid limit) and the boundary between the plastic and solid states (plastic limit).
BEDROCK-IN-PLACE	Continuous rock mass which essentially has not moved from its original depositional position.
CALCAREOUS	Containing calcium carbonate determined by effervescence when tested with dilute hydrochloric acid.
CHANNEL SANDSTONE	Sandstone that has been deposited in a streambed or other channel eroded into the underlying beds.
COLLUVIAL	Rock debris of various sizes loose from in-place bedrock mass, often shifted down gradient in conjunction with soil.
CROSS-BEDDING	Stratification which is inclined to the original horizontal surface upon which the sediment accumulated.
FISSILE BEDDING	Term applied to bedding which consists of laminae less than 2 millimeters in thickness.
FORMATION	A distinctive body of rock that serves as a convenient unit for study and mapping.
FOSSIL DETRITUS	The accumulation of broken, fragmented fossil debris.
FOSSILIFEROUS	Containing organic remains.
GLACIAL ERRATIC	A transported rock fragment different from the bedrock on which it lies, either free or as part of a sediment.
GLACIAL TILL	Nonsorted, nonstratified sediment carried or deposited by a glacier.
GLACIOFLUVIAL	Primarily deposited by streams from glaciers.
GROUP	A lithostratigraphic unit consisting of two or more formations.
JOINT	A fracture in a rock along which no appreciable displacement has occurred.

LIMESTONE	A sedimentary rock composed mostly of calcium carbonate ($CaCO_3$).
LOESS	A homogenous, nonstratified, unindurated deposit consisting predominantly of silt, with subordinate amounts of very fine sand and/or clay.
MICA	A mineral group, consisting of phyllosilicates, with sheetlike structures.
MEMBER	A specially developed part of a varied formation is called a member, if it has considerable geographic extent.
NODULE	A small, irregular, knobby, or rounded rock that is generally harder than the surrounding rock.
PERMEABILITY	The capacity of a material to transmit a fluid.
RECOVERY	The percentage of bedrock core recovered from a core run length.
RELIEF	The difference in elevation between the high and low points of a land surface.
RESIDUAL SOIL	Soil formed in place by the disintegration and decomposition of rocks and the consequent weathering of the mineral materials.
ROCK QUALITY DESIGNATION (RQD)	Refers to percentage of core sample recovered in unbroken lengths of 4 inches or more.
SANDSTONE	Sedimentary rock composed mostly of sand sized particles, usually cemented by calcite, silica, or iron oxide.
SERIES	A time-stratigraphic unit ranked next below a system.
SHALE	A fine-grained plastic sedimentary rock formed by consolidation of clay and mud.
STRATIGRAPHY	Branch of geology that treats the formation, compositions, sequence, and correlation of the stratified rocks as parts of the earth's crust.
SYSTEM	Designates rocks formed during a fundamental chronological unit, a period.
UNCONFORMITY	A surface of erosion or nondeposition, usually the former, which separates younger strata from older rocks.
WEATHERING	The physical and chemical disintegration and decomposition of rocks and minerals.

General Notes

Laboratory Test Symbols	
Symbol	**Definition**
LL	Liquid Limit (ASTM D4318)
PL	Plastic Limit (ASTM D4318)
PI	Plasticity Index (LL minus PL)
Qu	Unconfined Compressive Strength, Pounds per Square Foot (psf)
Qp	Pocket Penetrometer Reading, Tons per Square Foot (TSF)
RQD	Rock Quality Designation % (Sum of rock core pieces >4 inches/length of core run)

Common Soil Classification Symbols

Clay	
Symbol	**Soil Type**
CL	Low plasticity clay
CL-ML	Low plasticity clay and silt
CL/CH	Medium plasticity clay
CH	High plasticity clay

Silt	
Symbol	**Soil Type**
ML	Low plasticity silt
MH	High plasticity silt

Sand	
Symbol	**Soil Type**
SW	Well graded sand
SP	Poorly graded sand
SM	Silty sand
SC	Clayey sand

Gravel	
Symbol	**Soil Type**
GW	Well graded gravel
GP	Poorly graded gravel
GM	Silty gravel
GC	Clayey gravel

Descriptive Terminology

Cohesionless Soils

Relative Density Term	"N" Value
Very Loose	0 - 4
Loose	5 - 9
Medium Dense	10 - 29
Dense	30 – 49
Very Dense	50 or more

Cohesive Soils

Consistency Term	"N" Value
Very soft	0 – 2
Soft	3 – 4
Medium	5 – 8
Stiff	9 – 15
Very Stiff	16 - 30
Hard	> 30

Relative Proportions and Sizes

Term	Range
Trace	< 5%
A Little	5 – 15%
Some	15 – 30%
With	30 – 50%

Material	Size
Boulder	> 12"
Cobble	3" – 12"
Gravel	4.75 - 76.2 mm
Sand	0.075 – 4.75 mm
Silt and Clay	< 0.075 mm