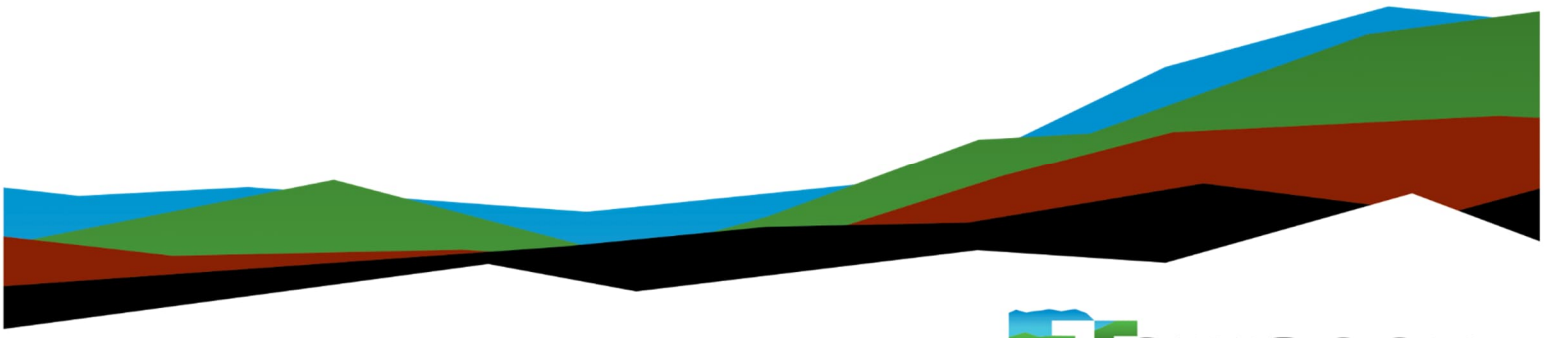
KCKCC Field House Floor Movement

Geotechnical Engineering Report

April 10, 2024 | Terracon Project No. 02245016

Prepared for:

Kansas City Kansas Community College
Kansas City, Kansas 66112



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April 10, 2024

Kansas City Kansas Community College
7250 State Avenue
Kansas City, Kansas 66112

Attn: Dr. Shelley Kneuvean
P: (913) 288-7645
E: skneuvean@kckcc.edu

Re: Geotechnical Engineering Report
KCKCC Field House Floor Movement
7250 State Avenue
Kansas City, Kansas
Terracon Project No. 02245016

Dear Ms. Kneuvean:

We have completed a subsurface exploration and geotechnical engineering evaluation for the referenced project in general accordance with Terracon Proposal No. P02245016 dated February 9, 2024. This report presents the findings of the subsurface exploration and provides geotechnical considerations regarding the floor flatness concerns at the stie.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon

Thomas R. Mast, E.I.
Senior Staff Engineer

Kole C. Berg, P.E.
Senior Consultant
Kansas: PE 16720

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Note: This report was originally delivered in a web-based format. Blue Bold text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

Refer to each individual Attachment for a listing of contents.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the existing KCKCC Field House located at 7250 State Avenue in Kansas City, Kansas. The purpose of these services was to provide information and geotechnical engineering considerations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Discussion of apparent cause of floor movement
- Considerations for remediation of floor movement

Drawings showing the site and boring locations are shown on the attached Site Location Plan and Exploration Plan. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs in Exploration Results.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	An email request was provided by Dalyn Novak with WSKF Architects and Chris Boos with Bob D. Campbell & Co. and on January 10, 2024. The request included a description of the historical and current issues at the site and photographs of the affected areas.
Project Description	Terracon performed two borings inside the existing KCKCC gymnasium to collect data, aid in determining cause of the current floor flatness issues, and provide considerations for remediation.

Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Project Location	The KCKCC field house is located at 7250 State Avenue in Kansas City, Kansas. Approximate Latitude/Longitude: 39.1245, -94.7477 (See Exhibit D)
Existing Improvements	Indoor athletic courts
Geology	The subsurface at the site consists of the soil and rock of the Lansing Group. The Lansing Group is comprised of cyclical limestone and shale members.

Geotechnical Characterization

We have developed a general characterization of the subsurface conditions based on the subsurface exploration, laboratory data, geologic setting, and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical evaluation. Conditions observed at each boring location are indicated on the individual logs. The individual logs are in the Exploration Results attachment of this report.

As part of our analyses, we identified the following model layers within the subsurface profile.

Model Layer	Layer Name	General Description
1	Fill	Light brown, dry, lean clay
2	Native Clay	Brown, stiff, moist, fat clay

The borings were observed during drilling and shortly after completion of drilling for the presence and level of water. Groundwater was not encountered in the borings at these times.

Subsurface Exploration

Terracon conducted two borings within the affected portion of the slab in the gymnasium. Boring B-1 was extended to a depth of 17 feet and 5 samples were collected. Boring B-2 was extended to a depth of 15 feet and 3 samples were collected. The floor slab was approximately 4 inches thick. The clay subgrade below the slab consisted of desiccated (extremely dry) clay.

In the laboratory, the samples extruded from the tubes were tested for moisture content and dry density and visually classified in general accordance with the Unified Soil Classification System (USCS).

Professional Opinions

The clay soils recovered from the boring locations are moderately plastic. Clay soils can shrink as moisture contents decrease and swell as moisture content increase. In our opinion, drying and shrinkage of subgrade soils resulted in portions of the overlying slab to settle. The cause of the drying and the resulting settlement was not clear from the available information. In our experience, drying of subgrade soils is often caused by tree roots extending beneath the slab, leakage of air from below-slab air ducts, or radon collection systems. At this time, none of these mechanisms has been confirmed as a potential cause for the drying.

Considerations for Remediation

Based on the data acquired, the information provided, and our knowledge and experience in this locale, it is our opinion that complete removal/replacement of the floor slab, along with removal of a portion of the desiccated subgrade soils and replacement with granular fill (such as KDOT AB-3 aggregate) would be the most comprehensive remedial method to address the slab settlement. It is our understanding removal/replacement of the floor slab is not economically feasible at this time, and KCKCC is planning to implement temporary measures to allow continued use of the existing floor.

Slab leveling and filling of voids below the slab (“poly jacking”) has been used in the past to provide temporary repair of the existing issue at this site. It is our opinion that these methods could be utilized again to achieve the same effect. Polymer grout material could be injected below the existing slab to support (and possibly re-level) the slab. Polymer grout is recommended instead of cement-based grout (“mud jacking”) due to the desiccated condition of the clay subgrade soils. Introduction of a cement-based grout, which has a substantial water content, is not recommended as wetting of the subgrade soils could cause swell, resulting in heaving of the floor slab. Terracon can provide the contact information for polymer grout injection contractors upon request.

General Comments

The data and opinions presented in this report are based upon the data obtained from the floor slab cores, borings, subgrade samples, laboratory tests and other information discussed in this report. This report reflects conditions only at the borehole locations.

Variations in floor slab thickness and subgrade condition may vary in areas outside our boring locations.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted professional practices. No warranties, express or implied, are intended or made.

Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet)	Location
2	15	Within the affected areas

Boring Layout and Elevations: Terracon personnel provided the boring layout using handheld GPS equipment (estimated horizontal precision of about ±10 feet) and referencing existing site features. Approximate ground surface elevations were estimated using Google Earth.

Subsurface Exploration Procedures: We advanced the borings with a portable rotary drill rig using continuous flight augers. Samples were obtained from the borings using thin-walled tube procedure. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge was pushed hydraulically into the soil to obtain a relatively undisturbed sample. The borings were backfilled with auger cuttings and bentonite chips after their completion. The upper few inches of borehole penetrations through were patched with pre-mixed concrete to match existing concrete thickness.

We also observed the boreholes while drilling and at the completion of drilling for the presence of groundwater. Groundwater was not observed in the boreholes at these times.

Our exploration team prepared field boring logs to record the sampling depths, penetration distances, other sampling information, visual classifications of the materials observed during drilling, and our interpretation of the subsurface conditions between samples. The samples were placed in appropriate containers and taken to our laboratory for testing and classification. The final boring logs provided with this report include modifications based on the results of the laboratory tests and observations of the recovered samples.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following tests on selected samples:

- Moisture Content
- Dry Unit Weight
- Unconfined Compression

- Atterberg Limits

The laboratory testing program included examination of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in general accordance with the Unified Soil Classification System.

Site Location and Exploration Plans

Contents:

Site Location Plan
Exploration Plan

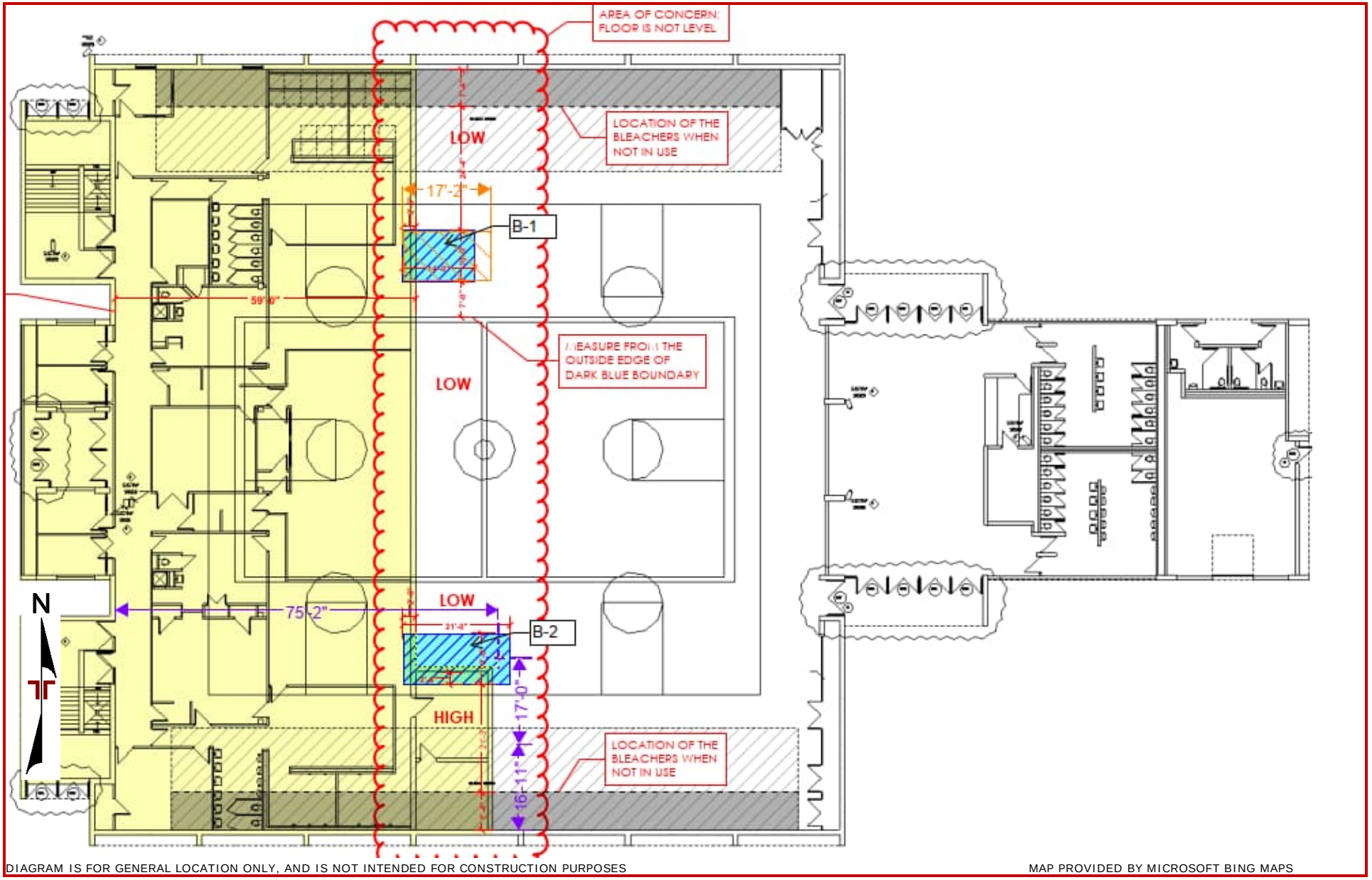
Note: All attachments are one page unless noted above.

Site Location

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan



Exploration and Laboratory Results

Contents:

Boring Logs (B-1 and B-2)

Note: All attachments are one page unless noted above.

KCKCC Field House Floor Movement
7250 State Avenue | Kansas City, KS
Terracon Project No. 02245016

Terracon
15620 W 113th St
Lenexa, KS

Boring Log No. B-1

Location: See Exploration Plan

Latitude: 39.1245° Longitude: -94.7477°

Graphic Log	Depth (Ft.)	Material Description	Depth (Ft.)	Water Level Observations	Sample Type	Recovery ()	Field Test Results	Unconfined Compressive Strength (psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	0.3	**CONCRETE (4 inches)**										
		LEAN CLAY, trace sand and gravel, light brown				5			3.9		44-22-22	
						16			5.5		45-21-24	97
			5									
						0						
			10			15			6.4		45-20-25	96
	12.0											
		FAT CLAY (CH), brown, stiff										
						18			23.3	103		
			15									
						16		2220	22.8	104		
	17.0											
		Boring Terminated at 17 Feet										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations

Drill Rig
Portable

Driller
Max's

Logged by

Boring Started
03-22-2024

Boring Completed
03-22-2024

Notes

Advancement Method
CFA

Abandonment Method

KCKCC Field House Floor Movement
7250 State Avenue | Kansas City, KS
Terracon Project No. 02245016

Terracon
15620 W 113th St
Lenexa, KS

Boring Log No. B-2

Location: See Exploration Plan

Latitude: 39.1244° Longitude: -94.7475°

Graphic Log	Depth (Ft.)		Depth (Ft.)	Water Level Observations	Sample Type	Recovery (%)	Field Test Results	Unconfined Compressive Strength (psf)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
	0.3	**CONCRETE (4 inches)**										
		LEAN CLAY, trace sand and gravel, light brown										
			5									
						26			15.3	107		
			10			26			18.1	106	45-21-24	
	12.0											
		FAT CLAY (CH), brown, stiff										
						14		2470	23.4	101		
	15.0		15									
		Boring Terminated at 15 Feet										

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Water Level Observations

Drill Rig
Portable

Driller
Max's

Logged by

Boring Started
03-22-2024

Boring Completed
03-22-2024

Notes

Advancement Method
CFA

Abandonment Method

Supporting Information

Contents:

General Notes
Unified Soil Classification System

Note: All attachments are one page unless noted above.

Terracon
15620 W 113th St
Lenexa, KS

General Notes

Sampling	Water Level	Field Tests
Shelby Tube	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

Relative Density of Coarse-Grained Soils
(More than 50% retained on No. 200 sieve.)
Density determined by Standard Penetration Resistance

Relative Density	Standard Penetration or N-Value (Blows/Ft.)
Very Loose	0 - 3
Loose	4 - 9
Medium Dense	10 - 29
Dense	30 - 50
Very Dense	> 50

Consistency of Fine-Grained Soils
(50% or more passing the No. 200 sieve.)
Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance

Consistency	Unconfined Compressive Strength Qu (tsf)	Standard Penetration or N-Value (Blows/Ft.)
Very Soft	less than 0.25	0 - 1
Soft	0.25 to 0.50	2 - 4
Medium Stiff	0.50 to 1.00	4 - 8
Stiff	1.00 to 2.00	8 - 15
Very Stiff	2.00 to 4.00	15 - 30
Hard	> 4.00	> 30

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 4 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines [C]	Cu≥4 and 1≤Cc≤3 [E]	GW	Well-graded gravel [F]
			Cu<4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines [D]	Cu≥6 and 1≤Cc≤3 [E]	SW	Well-graded sand [I]
			Cu<6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	PI > 7 and plots above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried}$ < 0.75	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic silt [K, L, M]
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried}$ < 0.75	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.
[E] $Cu = D_{60}/D_{10}$ $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.