PRELIMINARY GEOTECHNICAL SUBSURFACE EXPLORATION REPORT
PROPOSED HAUCK FARMS RESIDENTIAL DEVELOPMENT
(LOT 1, FOX CHASE 1ST AMENDED)
7624 COUNTY ROAD 5, FREDERICK, COLORADO
SOILOGIC # 17-1201

August 3, 2017

August 3, 2017

Steve & Ellene Kloepfer
1435 County Road 16½
Longmont, Colorado 80504

Re: Preliminary Geotechnical Subsurface Exploration Report
Proposed Hauck Farms Residential Development (Lot 1, Fox Chase 1st Amended)
7624 County Road 5
Frederick, Colorado
Soilogic Project # 17-1201

Mr. & Mrs. Kloepfer:

Soilogic, Inc. (Soilogic) personnel have completed the preliminary geotechnical subsurface exploration you requested for the proposed residential development to be constructed on a parcel of land referenced as Lot 1, Fox Chase 1st Amended, located at 7624 County Road 5 in Frederick, Colorado. The results of our preliminary exploration are included with this report.

The subsurface materials encountered in the completed test boring consisted of approximately 6 inches of alfalfa vegetation and topsoil underlain by light brown/brown/ rust clayey to silty sand with lean clay lenses. The clayey to silty sand varied from very loose to loose in terms of relative density, exhibited no swell potential at in-situ moisture and density conditions and extended to a depth of about 12½ feet below ground surface, where it was underlain by light brown/brown/rust sandy lean clay. The lean clay was soft in terms of consistency, would be expected to possess low swell potential at current moisture and density conditions and extended to the bottom of boring at a depth of approximately 15 feet below ground surface.

Groundwater was measured in borings B-1 at a depth of approximately 15 feet below present site grade when checked immediately after completion of drilling. When checked six (6) days after drilling, groundwater was measured at a depth of about 13 feet below ground surface. Groundwater level information is indicated in the upper right-hand corner of the attached boring log.

Based on the subsurface conditions encountered in the completed site boring, results of laboratory testing and type of construction proposed, we expect lightly-loaded residential

structures could be constructed with conventional footing foundations and floor slabs bearing on the site clayey to silty sand and/or lean clay with no to low swell potential.

Very loose to loose clayey to silty sand soils were encountered with depth in the completed site boring such that care will be needed to ensure footing foundations are supported on soils with suitable strength. Overexcavation/backfill procedures or other approved stabilization measures, or alternative deep foundation systems could be considered in areas of very loose sand to reduce the potential for excessive post-construction settlement of the proposed residences.

Based on the results of completed laboratory testing, the site clayey to silty sand and lean clay appear suitable for use as low volume change (LVC) fill to develop the site. Depending on the in-place moisture content of the subgrade soils at the time of construction, stabilization of pavement subgrade soils may become necessary prior to surfacing in order to develop a suitable paving platform. A final pavement exploration will be required for the development after the sanitary sewer has been installed and the street has been graded to approximate finish subgrade elevation in accordance with City of Frederick standards. Other preliminary opinions and recommendations concerning design criteria and construction details for the proposed site improvements are included with this report. Preliminary pavement section design estimates are also included.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the enclosed information or if we can be of further service to you in any way, please do not hesitate to contact us.

Very Truly Yours,
Soilogic, Inc.

Darrel DiCarlo, P.E.
Senior Project Engineer

Reviewed by:

Wolf von Carlowitz, P.E.
Principal Engineer

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INTRODUCTION

This report contains the results of the preliminary geotechnical subsurface exploration completed for a proposed single-family residential development to be constructed on a re-platted parcel of land located at the referenced address in Frederick, Colorado. The purpose of our exploration was to describe the subsurface conditions encountered in the completed site boring and develop preliminary recommendations concerning design and construction of residence foundations and support of floor slabs and site pavements. Recommendations concerning the installation of site utilities and preliminary pavement section estimates for interior site roadway are also included. The conclusions and recommendations outlined in this report are based on the results of the completed field and laboratory testing and our experience with subsurface conditions in this area.

PROPOSED CONSTRUCTION

The proposed development parcel includes approximately 38 acres that we understand will be developed as single-family residential. We understand the initial phase of development will consist of three (3) 1-acre lots. We expect the new residential structures will be lightly-loaded one or two story wood frame structures which may include full basements, where feasible. Foundations loads for the structures are expected to be light, with continuous wall loads less than 3 to 4 kips per lineal foot and individual column loads less than 75 kips. Floor loads are expected to be light, less than 100 psf. Infrastructure improvements for the development will include utility installation and roadway construction. We expect the site roadway will be used by low volumes of passenger vehicles and light trucks, with occasional heavy truck traffic. Anticipated grading to develop finish site grades is unknown at this time.

SITE DESCRIPTION

The development parcel is identified as Lot 1, Fox Chase 1st Amended and includes a total of approximately 38 acres located at 7624 County Road 5 in Frederick, Colorado. At the time of our site exploration, the ground surface across the development property contained a moderate to dense growth of alfalfa and was relatively level, with a slight downward slope to the northwest. The maximum difference in ground surface elevation across the development property is estimated to be approximately 10 feet based upon review of available USGS topographic maps of the area. The site appears to have been drilled for oil/gas production in the past, as evidenced by a well-head on the central portion of the property and associated collection equipment located adjacent to the northeastern property boundary. Evidence of prior building construction was not observed across the remainder of the site at the time of drilling.

SITE EXPLORATION

Field Exploration

One (1) soil boring was extended to a depth of approximately 15 feet below present site grade on Lot 3 of the proposed initial phase of development in order to develop preliminary geotechnical subsurface information across this area of the development parcel. The approximate boring location was selected by a representative of the client and established in the field by Soilogic personnel by pacing and estimating angles and distances from identifiable site references. The boring location should be considered accurate only to the degree implied by the methods used to make the field measurements. A diagram indicating the approximate boring location is included with this report. A graphic log of the auger boring is also included.

The test hole was advanced using 4-inch diameter continuous-flight auger powered by a truck-mounted CME-45 drill rig. Samples of the subsurface materials were obtained at regular intervals using California barrel sampling procedures in general accordance with ASTM specification D-1586. As part of the D-1586 sampling procedure, the standard sampling barrel is driven into the substrata using a 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the sampler a distance of 12

inches is recorded and helpful in estimating the consistency or relative density of the soils encountered. In the California barrel sampling procedure, lesser disturbed samples are obtained in removable brass liners. Samples of the subsurface materials obtained in the field were sealed and returned to the laboratory for further evaluation, classification and testing.

Laboratory Testing

The samples collected were tested in the laboratory to measure natural moisture content and visually and/or manually classified in accordance with the Unified Soil Classification System (USCS). The USCS group symbols are indicated on the attached boring log. An outline of the USCS classification system is included with this report.

As part of the laboratory testing, a calibrated hand penetrometer (CHP) was used to estimate the unconfined compressive strength of essentially-cohesive specimens. The CHP also provides a more reliable estimate of soil consistency than tactual observation alone. Dry density, Atterberg limits, -200 wash and swell/consolidation tests were completed on selected samples to help establish specific soil characteristics. Atterberg limits tests are used to determine soil plasticity. The percent passing the #200 size sieve (-200 wash) test is used to determine the percentage of fine-grained materials (clay and silt) in a sample. Swell/consolidation tests are performed to evaluate soil volume change potential with variation in moisture content. The results of the completed laboratory tests are outlined on the attached boring log and swell/consolidation test summaries.

SUBSURFACE CONDITIONS

The subsurface materials encountered in the completed test boring consisted of approximately 6 inches of alfalfa vegetation and topsoil underlain by light brown/brown/ rust clayey to silty sand with lean clay lenses. The clayey to silty sand varied from very loose to loose in terms of relative density, exhibited no swell potential at in-situ moisture and density conditions and extended to a depth of about 12½ feet below ground surface, where it was underlain by light brown/brown/rust sandy lean clay. The lean clay was soft in terms of consistency, would be expected to possess low swell potential at current

moisture and density conditions and extended to the bottom of boring at a depth of approximately 15 feet below ground surface.

The stratigraphy indicated on the included boring log represents the approximate location of changes in soil types. Actual changes may be more gradual than those indicated.

Groundwater was measured in borings B-1 at a depth of approximately 15 feet below present site grade when checked immediately after completion of drilling. When checked six (6) days after drilling, groundwater was measured at a depth of about 13 feet below ground surface. Groundwater level information is indicated in the upper right-hand corner of the attached boring log.

Groundwater levels will vary seasonally and over time based on weather conditions, site development, irrigation practices and other hydrologic conditions. Perched and/or trapped groundwater conditions may also be encountered at times throughout the year. Perched water is commonly encountered in soils overlying less permeable soil layers and/or bedrock. Trapped water is typically encountered within more permeable zones of layered soil and bedrock systems. The location and amount of perched/trapped water can also vary over time.

ANALYSIS AND RECOMMENDATIONS

General

As previously outlined, very loose clayey to silty sand soils were encountered with depth in the completed site boring. The clayey to silty sand would be expected to be elevated in moisture content and very loose near basement foundation bearing levels and could be easily disturbed by grading and construction activities. Care should be taken to avoid disturbing the site soils prior to placement of any fill or overlying improvements. Soils which are disturbed by the construction activities or allowed to dry out or become wet and softened should be removed and replaced or reworked in place prior to construction of any overlying improvements.

The very loose clayey/silty sand encountered in the completed site borings would be subject to consolidation under additionally imposed fill loads. Areas of the site expected to receive fill depths greater than 4 to 5 feet should be developed as early as possible in the construction process. We recommend grading fill materials in these areas be placed and allowed to remain in place for a minimum of four (4) weeks prior to the installation of site utilities and construction of any overlying improvements in order to allow for consolidation of underlying soils.

Site Development

The site currently contains an alfalfa crop and these root systems are known to extend to depths of 18 inches or more below ground surface. All existing vegetation and topsoil/ alfalfa root systems should be removed from any proposed new fill and pavement areas. In addition, all tree root systems and dry and desiccated soils associated with the tree root systems (if any) should be completely removed from within the areas of the proposed residences and beneath exterior flatwork/pavements. The depth and extent of required removal can best be established at the time of development through openhole observation. If/where required, the excavated/removed materials should be replaced as controlled and compacted fill as outlined below.

After stripping and completing all cuts and prior to placement of any overlying fill and/or pavement materials, we recommend the exposed subgrade soils be scarified to a depth of 9 inches, adjusted in moisture content and compacted to at least 95% of the materials standard Proctor maximum dry density. The moisture content of the reconditioned subgrade soils should be adjusted to be within the range of ±2% of standard Proctor optimum moisture content at the time of compaction. Loose clayey to silty sand soils were encountered near-surface at the location of our test boring. Depending on the depth of site cuts, stabilization procedures may be required in some areas to develop a suitable working platform.

Fill soils required to develop structural areas of the site should consist of approved low volume change (LVC) soils free from organic matter, debris and other objectionable materials. Based on the results of the completed laboratory testing, it is our opinion the site clayey to silty sand and lean clay could be used as fill to develop the site. If it is

necessary to import fill material to the site, those materials should have low potential for volume change and be approved prior to use. We recommend suitable fill materials be placed in loose lifts not to exceed 9 inches thick, adjusted in moisture content and compacted as recommended for the scarified materials above.

The very loose clayey to silty sand soils encountered with depth would be easily disturbed by the construction activities. Care should be taken to avoid disturbing all subgrade soils and placed fill soils and the need for corrective action. Disturbed soils should be removed and replaced or reworked in place prior to placement of any overlying improvements.

Footing Foundations

Based on the materials encountered in the completed site boring and the results of laboratory testing, we expect lightly-loaded site structures could be supported on conventional spread footing foundations bearing on the natural undisturbed clayey to silty sand, lean clay and/or suitable fill soils placed and compacted as outlined above a minimum of three (3) feet above observed groundwater. The foundations for the individual structures should bear on like materials.

For design of footing foundations bearing on the natural site clayey to silty sand, lean clay and/or properly placed and compacted fill or overexcavation/backfill, maximum net allowable soil bearing pressures in the range of 1,000 to 2,000 psf appear usable.

Very loose clayey to silty sand soils with insufficient strength were encountered with depth in the test boring. Excessive settlement of improvements placed directly on very loose clayey to silty sand would be expected.

Individual site explorations and careful observation of all foundation bearing soils should be completed for each of the proposed structures to ensure those improvements will be supported on soils with suitable strength. Overexcavation/backfill procedures or other approved stabilization measures, or alternative deep foundation systems could be considered in areas of very loose sand to reduce the potential for excessive post-construction settlement of the supported structures.

Floor Slabs

Based on the soils encountered in the test boring and results of the completed laboratory testing, we expect lightly-loaded floor slabs could be supported on reconditioned natural site sols and/or properly placed and compacted fill developed as outlined above in the 'Site Development' section of this report.

Care should be taken to avoid disturbing floor slab subgrades prior to concrete placement. Subgrade soils expected to receive flatwork concrete should be evaluated closely prior to surfacing. If areas of disturbed, wet and softened, or dry subgrade soils develop during construction, those materials should be removed and replaced or reworked in place prior to placement of the overlying improvements.

Below-Grade Construction

We recommend perimeter drain systems be installed around all below-grade areas to help reduce the potential for development of hydrostatic pressures behind the below-grade walls and water infiltration into the crawl space and/or basement areas of the residences. A perimeter drain system should consist of a 4-inch diameter perforated drain pipe surrounded by a minimum of six (6) inches of free-draining gravel. A filter fabric should be considered around the free-draining gravel or perforated pipe to reduce the potential for an influx of fine-grained soils into the system. The drain pipe should be placed at approximate foundation bearing level around the interior perimeter of crawl space areas and exterior perimeter of basement areas and run to a sump pit and pump system, free outfall or project underdrain system with a minimum slope of ⅛-inch per foot to facilitate efficient water removal. If free outfalls will be considered, measures to help reduce the potential for reverse flow and animal access into the systems should be considered.

Backfill placed adjacent to the below-grade walls should consist of LVC potential and relatively impervious soils which are free from organic matter, debris and other objectionable materials. The site clayey to silty sand and lean clay could be used as fill in these areas. The backfill soils should be placed in loose lifts not to exceed 9 inches thick, adjusted in moisture and compacted as previously outlined in the "Site Development" section of this report.

Excessive lateral stress can be imposed on below-grade walls when using heavier mechanical compaction equipment. We recommend compaction of unbalanced basement wall backfill be completed using light mechanical or hand compaction equipment.

Utility Installation

Bedding around utility pipelines should be placed in accordance with recommendations from the pipeline designer. Backfill soils placed above pipelines should consist of approved materials which are free from organic matter, debris and other objectionable materials. The on-site clayey/silty sand and lean clay could be used as pipeline backfill. Pipeline backfill should be placed in maximum 9-inch loose lifts, adjusted in moisture and compacted as previously outlined in the "Site Development" section of this report. Wet soils encountered with depth would need to be dried out prior to placement as utility backfill.

Utility excavations will likely expose the overburden clayey/silty sand and lean clay. The clayey/silty sand materials would be particularly susceptible to sloughing and caving during excavation. Care will be needed to ensure utilities are not placed on or above disturbed or sloughed materials. In addition, care will be needed to develop stable side slopes in pipeline trenches excavated through some of the very loose sands. As such, we expect temporary shoring, bracing, or cutting of shallow slopes will be necessary in deeper excavations. Excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards. As a safety measure, it is recommended that vehicles and soil stockpiles be kept to a minimum lateral distance from the top edge of utility excavations equal to no less than the depth of utility excavation.

Cuts below groundwater elevation will require dewatering to facilitate proper construction. We expect a majority of the dewatering procedures could be completed through open pumping procedures in sumps fed from ditches or sloped trench excavations. Deeper utility excavations and excavations which expose cleaner sand and gravel soils may require well-point systems for proper dewatering.

Site Roadways

We expect the pavement subgrades will consist of clayey to silty sand with no to low swell potential. These soils classify as A-4 and A-2-4 soils in accordance with The American Association of State Highway and Transportation Officials (AASHTO) classification system and would be expected to exhibit low to moderate remolded shear strength. Pavement subgrades should be developed as outlined in the "Site Development" section of this report. If importing of soils will be completed to develop finish roadway subgrade levels, those materials should consist of approved LVC soils which possess a liquid limit of 40 or less and plasticity index of 20 or less. If the site access drive will be a public improvement, a final subgrade evaluation and pavement section design report will be required after the roadway is developed to approximate finish grade in accordance with Town of Frederick standards. For preliminary design estimates, a composite pavement section consisting of 3 inches of asphaltic concrete overlying 6 inches of aggregate base course, or full-depth pavement section consisting of 5½ inches of asphalt could be used.

The clayey/silty sand soils encountered at this site would be particularly susceptible to strength loss and instability when elevated in moisture content, with a tendency to rut and pump when subjected to vehicle traffic. Depending on the in-place moisture content of the subgrade soils, time of year when construction occurs and other hydrologic conditions, stabilization of site pavement subgrades may become necessary to develop a suitable paving platform. If required, we recommend consideration be given to stabilization of the pavement subgrades with Class C fly ash. Fly ash stabilization can also eliminate some of the uncertainty associated with attempting to pave during periods of inclement weather.

Drainage

Positive drainage is imperative for satisfactory long-term performance of the proposed site residences and associated site improvements. We recommend positive drainage be developed away from all site structures and pavement areas to reduce the potential for wetting of the subgrade and bearing materials. Water which is allowed to pond adjacent

to the site improvements can result in unacceptable performance of those improvements over time.

LIMITATIONS

This report was prepared based upon the data obtained from the completed site exploration, laboratory testing, engineering analysis and any other information discussed. The completed boring provides an indication of subsurface conditions at the boring location only. Variations in subsurface conditions can occur in relatively short distances away from the boring. This report does not reflect any variations which may occur across the site or away from the boring. If variations in the subsurface conditions anticipated become evident, the geotechnical engineer should be notified immediately so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any biological or environmental assessment of the site or identification or prevention of pollutants or hazardous materials or conditions. Other studies should be completed if concerns over the potential of such contamination or pollution exist.

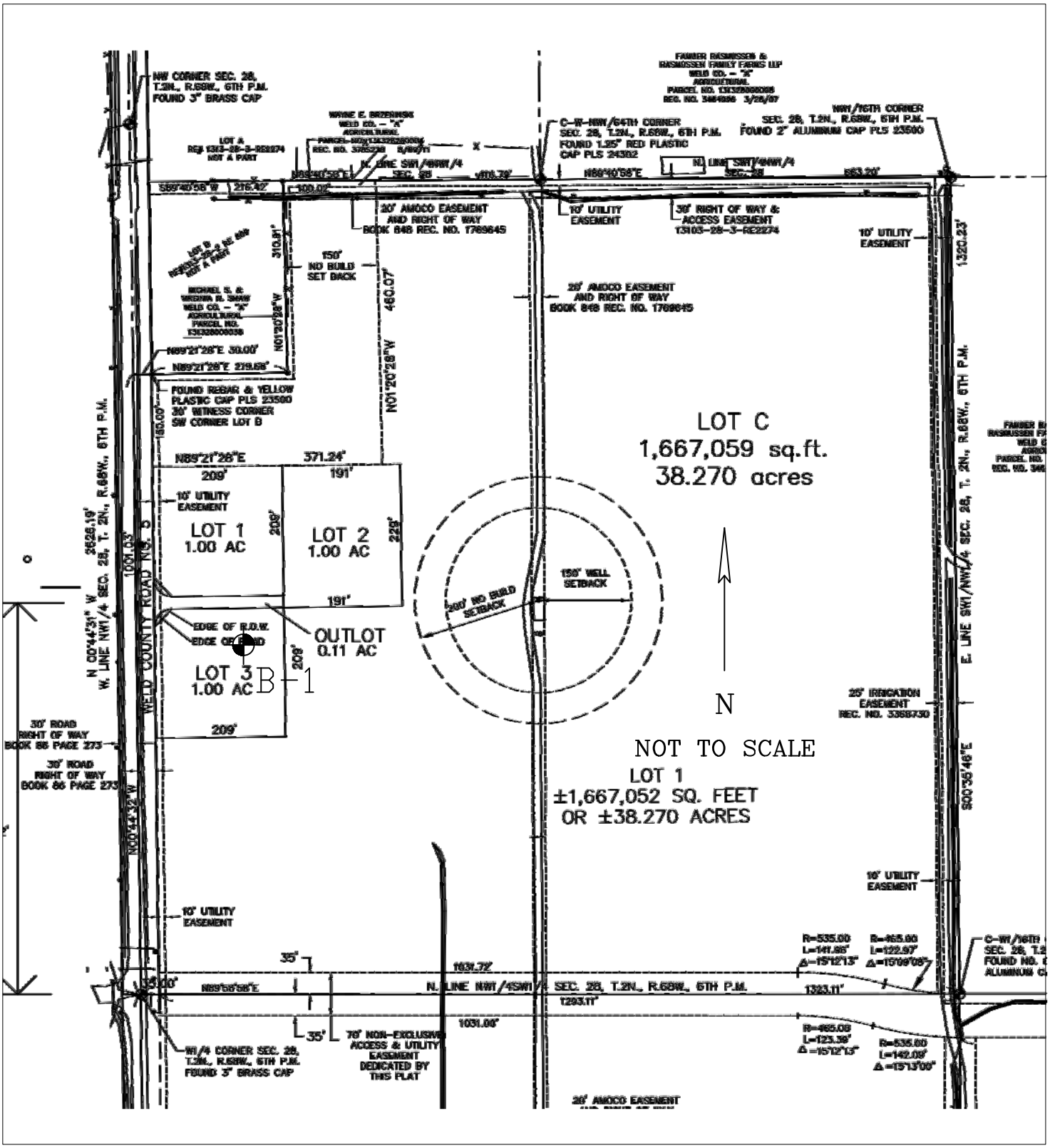
The geotechnical engineer should be retained to review the plans and specifications so that comments can be made regarding the interpretation and implementation of our geotechnical recommendations in the design and specifications. The geotechnical engineer should also be retained to provide testing and observation services during construction to help determine that the design requirements are fulfilled.

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 the generally accepted standard of care for the profession. No warranties express or implied, are made. The conclusions and recommendations contained in this report should not be considered valid in the event that any changes in the nature, design or location of the project as outlined in this report are planned, unless those changes are reviewed and the conclusions of this report modified and verified in writing by the geotechnical engineer.

AUGUST 2017
PROJECT #17-1201

BORING LOCATION DIAGRAM

SOILOGIC



PROPOSED HAUCK FARMS RESIDENTIAL DEVELOPMENT (LOT 1, FOX CHASE 1st AMENDED)
7624 COUNTY ROAD 5, FREDERICK, COLORADO

HAUCK FARMS PRELIMINARY EXPLORATION

7642 COUNTY ROAD 5, FREDERICK, COLORADO
Project # 17-1201
August 2017

LOG OF BORING B-1

Sheet	1/1	Drilling Rig:	CME 45	Water Depth Information	
Start Date	6/20/2017	Auger Type:	4" CFA	During Drilling	15.0'
Finish Date	6/20/2017	Hammer Type:	Automatic	After Drilling	15.0'
Surface Elev.	-	Field Personnel:	WvC / ZG	6 Days After Drilling	13.0'

USCS	SOIL DESCRIPTION	Depth (ft)	Sampler	"N"	MC (%)	DD (pcf)	Estimated q_u (psf)	% Swell @ 500 psf	Swell Pressure (psf)	Atterberg Limits LL	Atterberg Limits PI	% Passing # 200 Sieve (%)
	±6" ALFALFA VEGETATION	-										
	with ALFALFA root penetration	1 - 2										
		- 3	CS	14	6.4	113.3	9000+	None	<500	-	-	-
		- 4										
		- 5	CS	9	6.6	105.9	9000+	None	<500	21	3	36.0%
SC-SM w/CL	CLAYEY to SILTY SAND with LEAN CLAY lenses light brown, brown, rust very loose to loose	- 6 - 7 - 8 - 9										
		- 10	CS	5	14.6	116.4	9000+	None	<500	-	-	-
		- 11 - 12 - 13 - 14										
CL	SANDY LEAN CLAY light brown, brown, rust soft	- 15	CS	5	20.6	104.8	9000+	-	-	-	-	-
	BOTTOM OF BORING @ 15.0'	- 16 - 17 - 18 - 19 - 20 - 21 - 22 - 23 - 24 - 25										

HAUCK FARMS PRELIMINARY EXPLORATION

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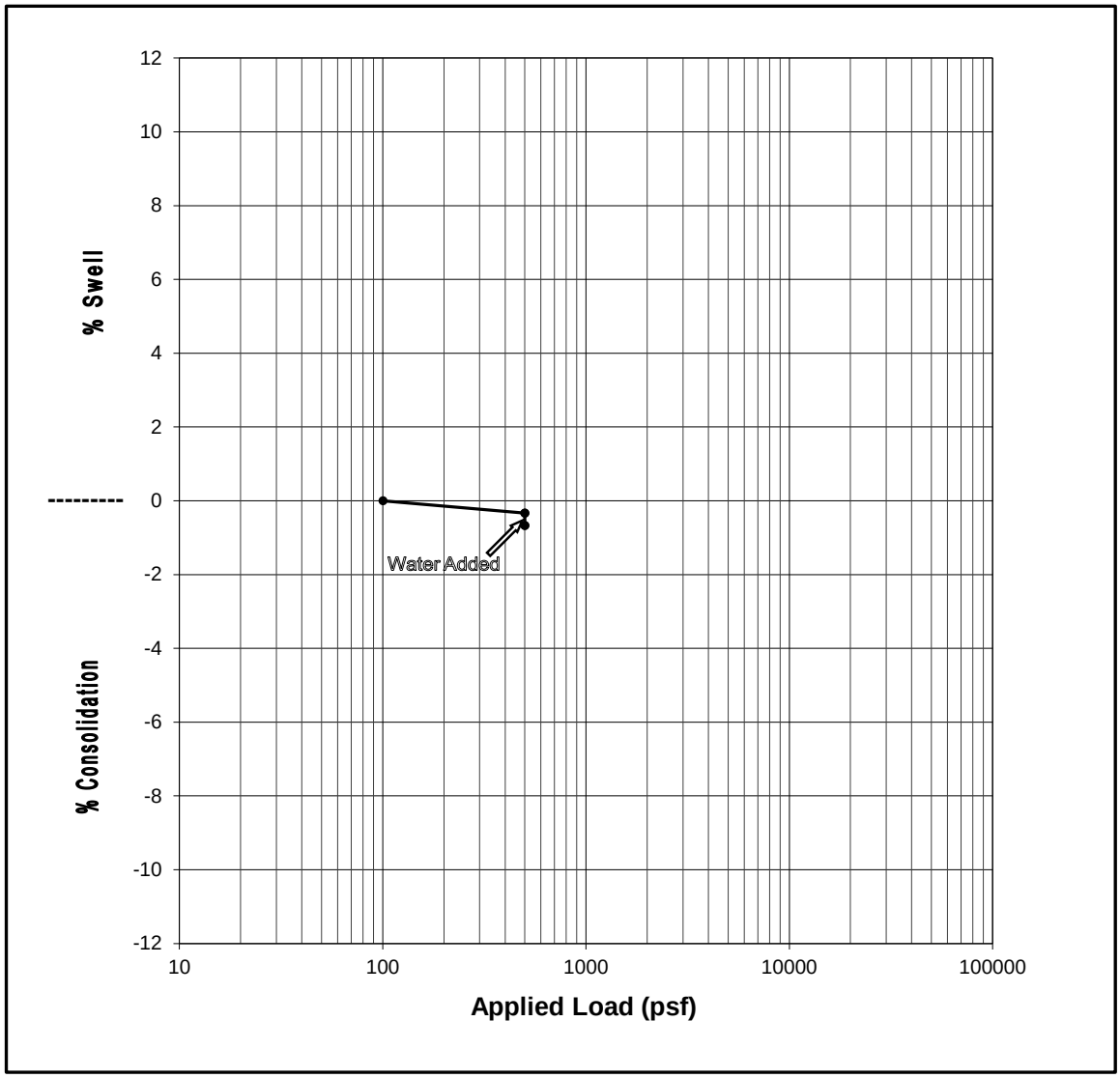
SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-1 @ 2

Sample Description: Light Brown Clayey to Silty Sand (SC-SM)

(Swell Only)

Initial Moisture	6.4%	Liquid Limit	-
Final Moisture	15.0%	Plasticity Index	-
% Swell @ 500 psf	None	% Passing #200	-
Swell Pressure (psf)	<500	Dry Density (pcf)	113.3

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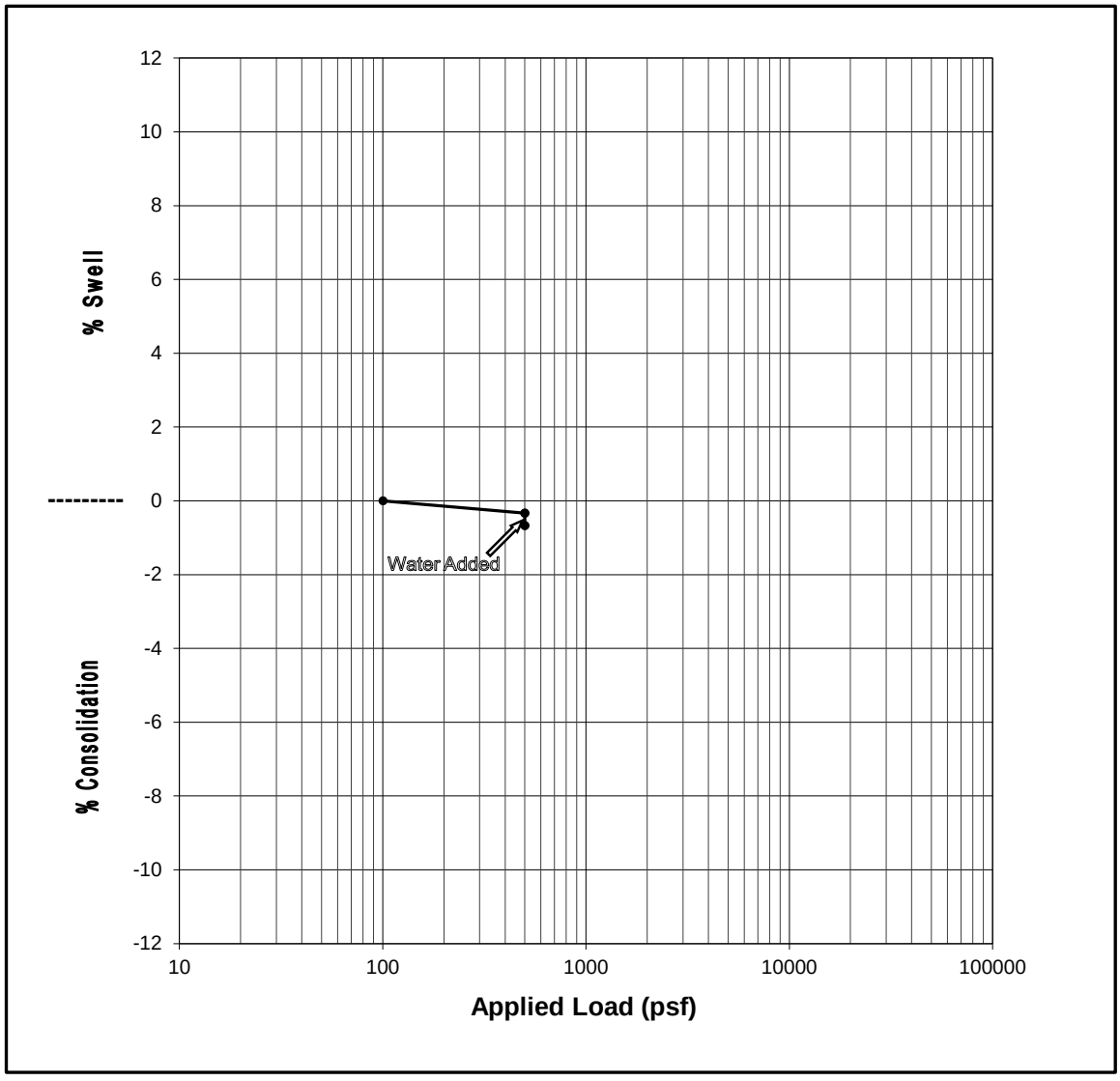
SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-1 @ 4

Sample Description: Light Brown Clayey to Silty Sand (SC-SM)

(Swell Only)

Initial Moisture	6.6%	Liquid Limit	21
Final Moisture	18.2%	Plasticity Index	3
% Swell @ 500 psf	None	% Passing #200	36.0%
Swell Pressure (psf)	<500	Dry Density (pcf)	105.9

HAUCK FARMS PRELIMINARY EXPLORATION

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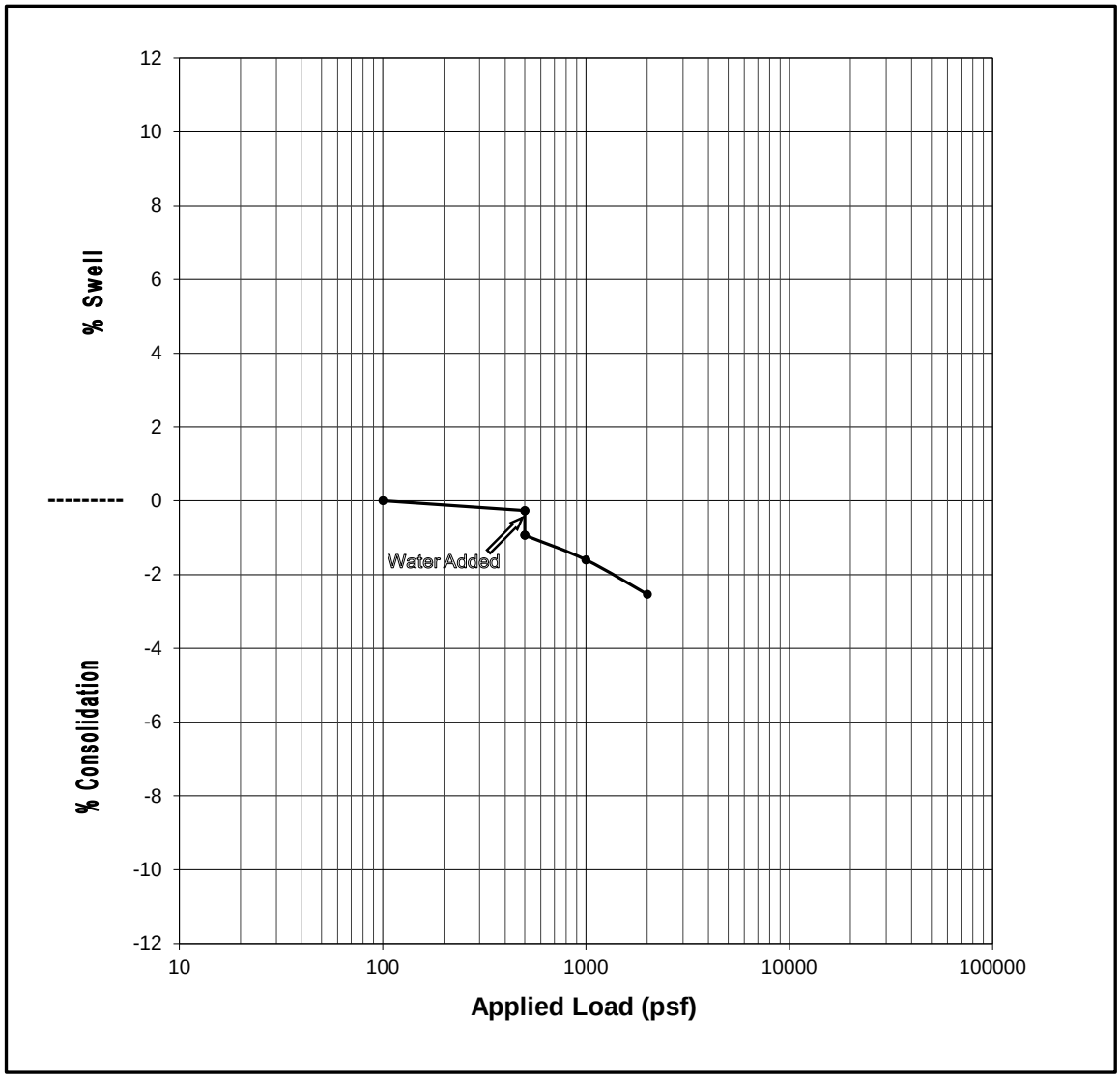
SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-1 @ 9

Sample Description: Light Brown Clayey to Silty Sand (SC-SM)

Initial Moisture	14.6%	Liquid Limit	-
Final Moisture	15.0%	Plasticity Index	-
% Swell @ 500 psf	None	% Passing #200	-
Swell Pressure (psf)	<500	Dry Density (pcf)	116.4

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. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]		GW	Well graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[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]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]		SW	Well graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[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 on or above "A" line[J]		CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]		ML	Silt[K,L,M]
		Organic	**Liquid limit - oven dried**	< 0.75	OL	Organic clay[K,L,M,N]
			Liquid limit - not dried			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	Liquid limit - oven dried	< 0.75	OH	Organic clay[K,L,M,P]
			Liquid limit - not dried			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-in. (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] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[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.

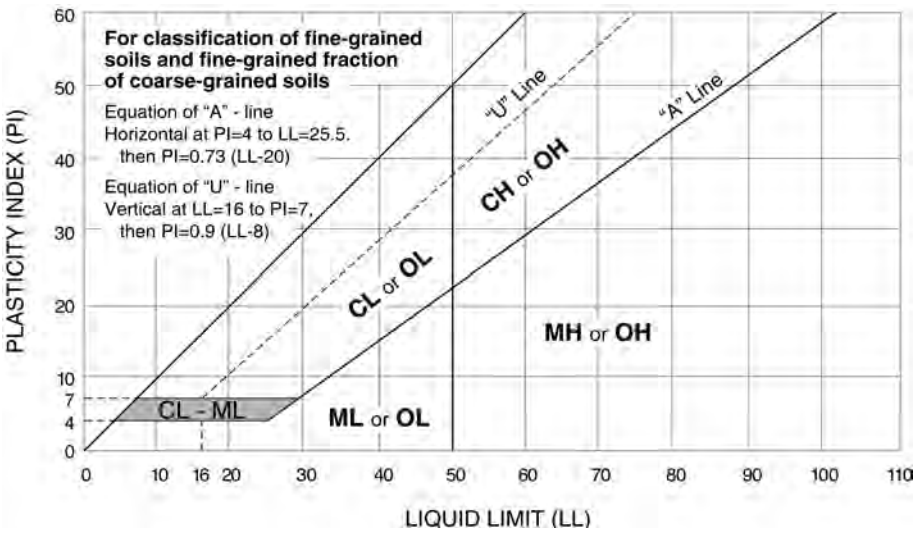
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[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.



GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1⅜" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube – 2.5" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
CS:	California Barrel - 1.92" I.D., 2.5" O.D., unless otherwise noted	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value". For 2.5" O.D. California Barrel samplers (CB) the penetration value is reported as the number of blows required to advance the sampler 12 inches using a 140-pound hammer falling 30 inches, reported as "blows per inch," and is not considered equivalent to the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling
WCI:	Wet Cave in	WD:	While Drilling
DCI:	Dry Cave in	BCR:	Before Casing Removal
AB:	After Boring	ACR:	After Casing Removal

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

FINE-GRAINED SOILS			COARSE-GRAINED SOILS			BEDROCK		
(CB) Blows/Ft.	(SS) Blows/Ft.	Consistency	(CB) Blows/Ft.	(SS) Blows/Ft.	Relative Density	(CB) Blows/Ft.	(SS) Blows/Ft.	Consistency
< 3	0-2	Very Soft	0-5	< 3	Very Loose	< 24	< 20	Weathered
3-5	3-4	Soft	6-14	4-9	Loose	24-35	20-29	Firm
6-10	5-8	Medium Stiff	15-46	10-29	Medium Dense	36-60	30-49	Medium Hard
11-18	9-15	Stiff	47-79	30-50	Dense	61-96	50-79	Hard
19-36	16-30	Very Stiff	> 79	> 50	Very Dense	> 96	> 79	Very Hard
> 36	> 30	Hard						

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Terms of Other Constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Terms of Other Constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	30+

SOILOGIC