Project No.
15571.001.000

July 19, 2021

Mr. Keith McCoy
UrbanMix Development LLC
149 New Montgomery Street, 4th Floor
San Francisco, CA 94105

Subject: Oyster Cove
Petaluma, California

LIMITED GEOTECHNICAL EXPLORATION

References:

1. Berlogar, Stevens, and Associates; Due Diligence Geotechnical Investigation, East D Street, APN: 007-700-003, -005, -006, and -007, Petaluma, California; December 19, 2020; Job No. 3995.100.
2. Urban Design Associates; Proposed Site Plan, Oyster Cove, Petaluma, California; August 20, 2020.
3. ENGEO; Geotechnical Peer Review, East D Street, Petaluma, California; September 21, 2020; Project No. 15571.001.000.

Dear Mr. McCoy:

We are pleased to present this letter summarizing our limited geotechnical exploration for your Oyster Cove development located in Petaluma, California. As you are aware, we previously performed a peer review of the Due Diligence Geotechnical Investigation, prepared by Berlogar Stevens and Associates (BSA), dated December 19, 2020. As a part of our review, we identified various data gaps that influenced their site preparation recommendations.

The purpose of this limited geotechnical exploration is to:

- Further characterize the liquefaction potential of certain marginal sandy silt to silty sand materials with laboratory index testing.
- Provide consolidation settlement estimates due to proposed fill and building placement.
- Estimate appropriate surcharge measures to mitigate consolidation settlement.
- Perform preliminary evaluation of static and seismic slope stability.

PROJECT DESCRIPTION AND SURFACE CONDITIONS

The approximately 10½-acre site is located along the southeast edge of D Street and is bisected by Copeland Street and what appears to be a manmade inlet that connects to the Petaluma River on the southern edge of the site. Train tracks and Lakeville Street border the northern edge, with a spur of the tracks encroaching through the northern portion of the site. The site is currently occupied by several commercial structures, paved drive and parking, and minor vegetation and trees.

The conceptual development plans prepared by Urban Design Associates, dated August 20, 2020, Reference 2, depict a residential community consisting of townhomes and mixed-use structures. In addition to the above-mentioned improvements, we anticipate the development will include minor ancillary structures, street and sidewalk paving, underground utilities, retaining structures, possible shoreline stabilization, and landscaping. Conceptual grading plans prepared by CBG Civil Engineers, dated August 31, 2020, show various thicknesses of fill across the site totaling approximately 4,000 cubic yards in volume to achieve a design elevation of approximately 13 feet.

PREVIOUS EXPLORATION AND FINDINGS

BSA's 2018 exploration of the site consisted of advancing eight cone penetration tests (CPTs) ranging in depth between 30 and 50 feet below the ground surface (bgs) and the review of various available published hazard and geologic maps. According to the geologic descriptions and exploration interpretations presented by BSA, the site can be uniquely characterized in two sections as the northern and southern portions of the site. The northern portion of the site is mapped as being underlain by Stream Terrace Deposits that are described as consisting predominantly of sand, with silt, gravel, and some clay. Exploration interpretations of the northern portion of the site are consistent with the mapped description. The southern portion of the site is underlain by Young Bay Mud (YBM), which is a soft, compressible, typically high plasticity clay deposit. Exploration interpretations of the southern portion of the site indicate interbedded silt and sand is likely below the YBM to the termination of the explorations. BSA notes potentially liquefiable material in both the northern and southern portions of the site.

CURRENT EXPLORATION

Our supplemental field exploration included three borings. Borings 1-B1 and 1-B1A were drilled using solid-flight auger and mud-rotary techniques. Boring 1-DP1 utilized truck-mounted direct-push methods to retrieve a continuous soil profile within a plastic sheathing through the explored depth.

We obtained the blow counts by dropping a 140-pound hammer through a 30-inch free fall. We drove the 2-inch O.D. split-spoon sampler 18 inches and recorded the number of blows for each 6 inches of penetration. In addition, 2.5-inch I.D. samples were obtained using a Modified California Sampler driven into the soil with the 140-pound hammer previously described. Unless otherwise indicated, the blows per foot recorded on the boring log represent the accumulated number of blows to drive the last 1 foot of penetration; we did not correct the blow counts using any correction factors. When sampler driving was difficult, we recorded penetration only as inches penetrated for 50 hammer blows.

An ENGEO representative observed the drilling and logged the subsurface conditions at each location. We permitted and backfilled the borings in accordance with the requirements of Sonoma County.

Figure 2 depicts exploration locations. Exploration logs in Attachment A depict subsurface conditions at each location. The logs contain the soil type, color, consistency, and visual classification in general accordance with the Unified Soil Classification System. The logs graphically depict the subsurface conditions encountered at the time of the exploration. Subsurface conditions encountered are generally in conformance with those described in the 2018 report by BSA.

LABORATORY TESTING

We performed laboratory tests on select soil samples to evaluate their engineering properties. For this project, we performed moisture content, dry density, unconfined compression, triaxial compression, miniature vane shear, plasticity index, consolidation, and grain size distribution testing. Laboratory data is included in Attachment B.

DISCUSSIONS AND FINDINGS

Based on review of the current site conditions, the prior exploration, this current study, and your project plans, it is our opinion that the proposed development and site improvements are feasible from a geotechnical standpoint. The following limited geotechnical recommendations should be considered during the design and construction phase of the project.

Liquefaction Analysis

Item 2 in our geotechnical peer review (Reference 3) comments on the liquefaction analysis performed as part of the Berlogar Stevens & Associates (BSA) report. The method followed by BSA assumes both granular and cohesive soil is potentially liquefiable and does not consider plasticity index as an indicator to the liquefaction susceptibility of the cohesive materials.

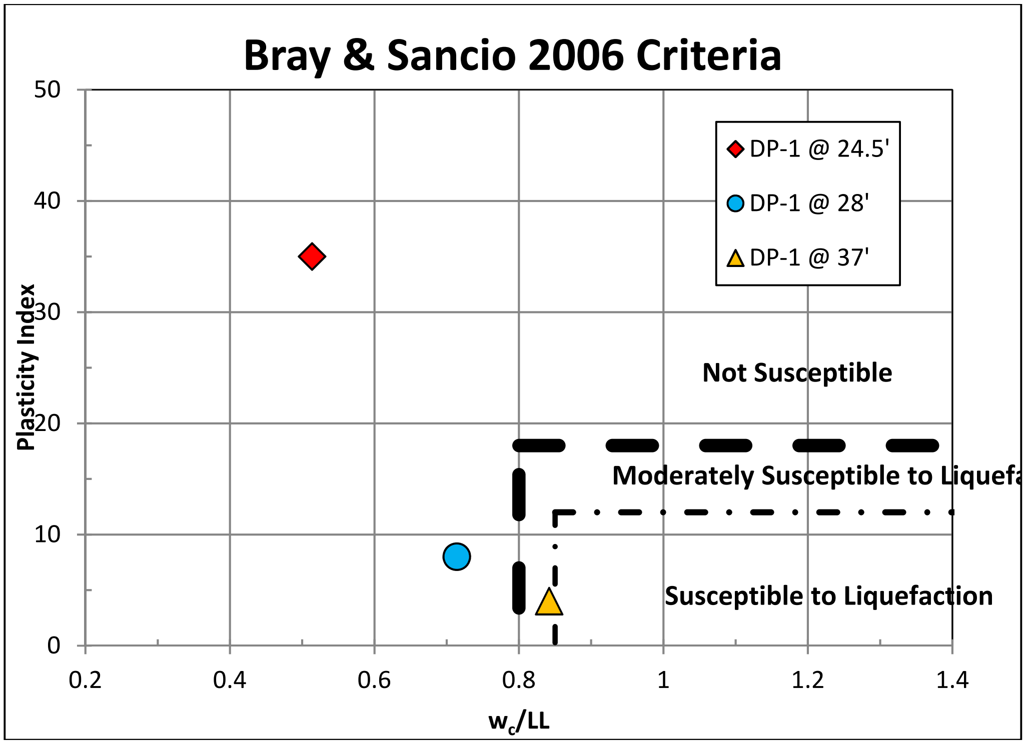
As part of this limited geotechnical exploration, we conducted one direct push boring (1-DP1) to a depth of 40 feet at a location adjacent to CPT-7 conducted by BSA in 2018. BSA identified this exploration as having the greatest magnitude of potential liquefaction-induced vertical settlement (approximately 2¾ inches) of all their explorations. We retrieved and performed laboratory testing on the soil samples from 1-DP1 that coincided with potentially cohesive layers to refine the liquefaction hazard.

We utilized the criteria presented by Bray and Sancio (2006) and our laboratory test results to refine our assessment of the liquefaction potential. Bray and Sancio observed that soil with a Plasticity Index (PI) of less than 12 and a water content (wc) to liquid limit (LL) ratio of more than 0.85 is susceptible to liquefaction/cyclic-softening. Soil with PI of greater than 18 and/or wc/LL of less than 0.8 was deemed to be not susceptible to liquefaction because it is too plastic and/or the water content is too low.

We considered the Bray and Sancio criteria at this site and plotted wc/LL versus PI for the laboratory data collected from the layers previously identified as potentially liquefiable. Laboratory data for samples collected at a depth of 24½ feet and 28 feet plot as not susceptible to liquefaction based on these criteria. Liquefaction-induced vertical settlement from these layers amounted to approximately 1 inch. Laboratory data collected from deeper layers identified soil that is susceptible to liquefaction. We noted several shallower granular layers, that when coupled with the previous analysis, we consider susceptible to liquefaction and subsequently were not tested.

Our refined liquefaction analysis for CPT-7 estimates a total liquefaction induced vertical settlement of 1¾ inches. Results of our analysis based on Bray and Sancio are shown in Exhibit 1.

EXHIBIT 1 – Bray and Sancio Analysis Results



CPTs conducted elsewhere throughout the site identified up to 2¼ inches of liquefaction-induced settlement. Like the results from CPT-7, these estimates also included liquefaction occurring in cohesive materials. Based on the results of the Bray and Sancio analysis and visual observations made in the borings conducted at the site, we opine the BSA analysis overestimates the level of vertical settlement. We estimate liquefaction-induced vertical settlement throughout the site of up to 1¾ inches.

Ground Improvement

Item 3 in our geotechnical peer review (Reference 3) comments on ground improvement recommended by BSA in their 2018 report. BSA presents a variety of ground improvement options, which include in situ grouting, cement deep soil mixing (CDSM), and/or vibro-replacement stone columns. We recognize the proposed mitigations may solve one or more of the identified hazards; however, we opine that a surcharge program may be more appropriate to mitigate the hazards present.

As part of this limited geotechnical exploration, we collected soil samples from borings 1-B1 and 1-B1A to conduct further analysis of the YBM to determine consolidation susceptibility, in situ strength, and potential for future strength gains due to surcharging. For the purposes of this limited analysis, we used strength parameters to perform slope stability analysis based on the current in situ strength. We performed consolidation testing on the YBM deposits to evaluate appropriateness of a surcharge program.

Slope Stability

Geometry and Idealized Soil Parameters

Conceptual grading plans prepared by CBG, dated August 31, 2020, provided existing topographic information. Additionally, CBG provided a conceptual river frontage plan depicting proposed slopes along the Petaluma River to include retaining walls of up to 3.5 feet and slopes of 2.5:1 (horizontal:vertical) maximum gradient. We used these conceptual plans as the basis of our slope stability analysis. Subsurface conditions were interpreted using available explorations from the 2018 BSA report and this limited geotechnical exploration. We conducted slope stability analysis on one cross section. The location of this cross section is depicted on Figure 2.

Prior to performing slope stability analyses, we evaluated the shear strength of the soil profile. To obtain shear strength data, we analyzed CPT data and various laboratory test results obtained during this limited geotechnical exploration. We derived strength parameters assigned to each soil layer primarily from laboratory data provided in Attachment B. Based on our data review, we developed the idealized soil profiles shown in Attachment C.

Method of Analysis

We used the program Slide2, 2D Limit Equilibrium Analysis for Slopes, version 9.001 and a search routine with circular surfaces to estimate the minimum factor of safety and critical slip surface location. We used Spencer’s method for slope stability analysis; this analytical method is an iterative solution that satisfies both force and moment equilibrium and assumes all slice side forces have the same inclination.

In evaluating the stability of slopes under seismic conditions, we used a “pseudostatic” method of analysis. The pseudostatic method models the effects of transient or pulsating earthquake loading on a potential slide mass by using an equivalent sustained horizontal force that is the product of a seismic coefficient and the weight of the potential slide mass. We used a two-stage analysis where in the first stage the shear strengths along each surface are developed under static conditions. In the second stage, an additional horizontal force acting in the direction of potential failure is imposed on the sliding mass. This two-stage procedure is performed for each surface in the search and a surface with the lowest factor of safety is found. The additional horizontal force is equal to the soil mass multiplied by a horizontal seismic coefficient.

We selected the design seismic coefficient based on the procedure outlined in California Geological Survey Special Publication 117A (SP 117A). We used a value of 0.41g as MHAr based on two-thirds of the Maximum Credible Earthquake peak ground acceleration (PGA), which correlates to the Building Code Design Earthquake PGA. We used a magnitude 7.25 earthquake based on the site’s proximity to the Rodgers Creak - Healdsburg fault. Based on this, we used a seismic coefficient of 0.18g based on an upper-bound displacement value (u) of 15 cm (6 inches) and site earthquake information.

Acceptable Factors of Safety and Results of Analysis

The Factor of Safety (FS) is defined as the sum of available shear strength resistance divided by mobilized shear strength. A FS value less than 1.0 indicates slope instability, and the greater the FS, the greater the anticipated stability of the slope. Our analyses for this evaluation are derived from information published in previous reports, recently performed explorations, laboratory testing, and details outlined in SP 117A. We consider a FS of 1.5 for the static condition and a FS of 1.0 for the seismic condition to be appropriate criteria for this analysis.

We performed slope stability analyses for both static and pseudostatic conditions. We conducted a sensitivity analysis of our shear strength profile to consider worst case scenarios in our profile interpretation. As shown in Appendix C, the static factors of safety under existing conditions are greater than 1.5 and seismic factors of safety are greater than 1.0 for conditions considered. As described in SP 117A, slopes that have a pseudostatic factor of safety greater than 1.0 using a seismic coefficient derived from this screening analysis procedure can be considered stable.

Our slope stability analyses will be further refined during review of final grading plans based on the actual site topography and proposed site grades.

Surcharge Program

As discussed in the BSA report, the southern portion of the site is underlain with soft saturated clay deposits ranging from approximately 6 feet to 12 feet thick. Our laboratory consolidation test results indicate that this material consists of compressible, normally consolidated to slightly over-consolidated clay, which will compress when subjected to increased loads resulting in settlement at the ground surface. Settlement at the site could be generated from: (1) consolidation of the clay deposits where additional fill will be placed, (2) compression of the fill due to its own weight, and (3) compression of soil beneath foundation system due to building load. The amount of settlement is a factor of proposed loads, thickness of the clay deposit, and previous loads experienced by the clay deposits.

Our settlement analyses indicate that the total settlement due to consolidation of clay deposits when subjected to additional loads (assuming 12 feet soft clay thickness, fill thickness of 3 feet, and assumed building loads of 500 pounds per square foot, psf) could be as much as 1 to 1½ feet.

To reduce post-construction consolidation settlement, the southern portion of the site can be preloaded using surcharge fill. For preliminary conceptual purposes, we estimate a surcharge height of 9 feet. We estimate this surcharge will need to remain in place for a duration of 3 to 6 months to achieve the required level of consolidation.

The evaluation of surcharge fill program, if desired, can be conducted during review of the final grading plans, based on final fill thickness and actual building load.

CLOSING AND LIMITATIONS

This letter presents limited geotechnical findings for conceptual level design of Oyster Cove as described in the project description. A design-level report including further exploration should be performed to support future plans. If changes occur in the nature or design of the project, we should be allowed to review this report and provide additional recommendations, if any. It is the responsibility of the owner to transmit the information and recommendations of this report to the appropriate organizations or people involved in design of the project, including but not limited to developers, owners, buyers, architects, engineers, and designers. The conclusions and recommendations contained in this report are solely professional opinions and are valid for a period of no more than 2 years from the date of report issuance.

We strived to perform our professional services in accordance with generally accepted principles and practices currently employed in the area; no warranty is provided, express or implied. There are risks of earth movement and property damages inherent in building on or with earth materials. We are unable to eliminate all risks; therefore, we are unable to guarantee or warrant the results of our services.

If you have any questions or comments regarding this update, please call and we will be glad to discuss them with you.

Sincerely,

ENGEO Incorporated

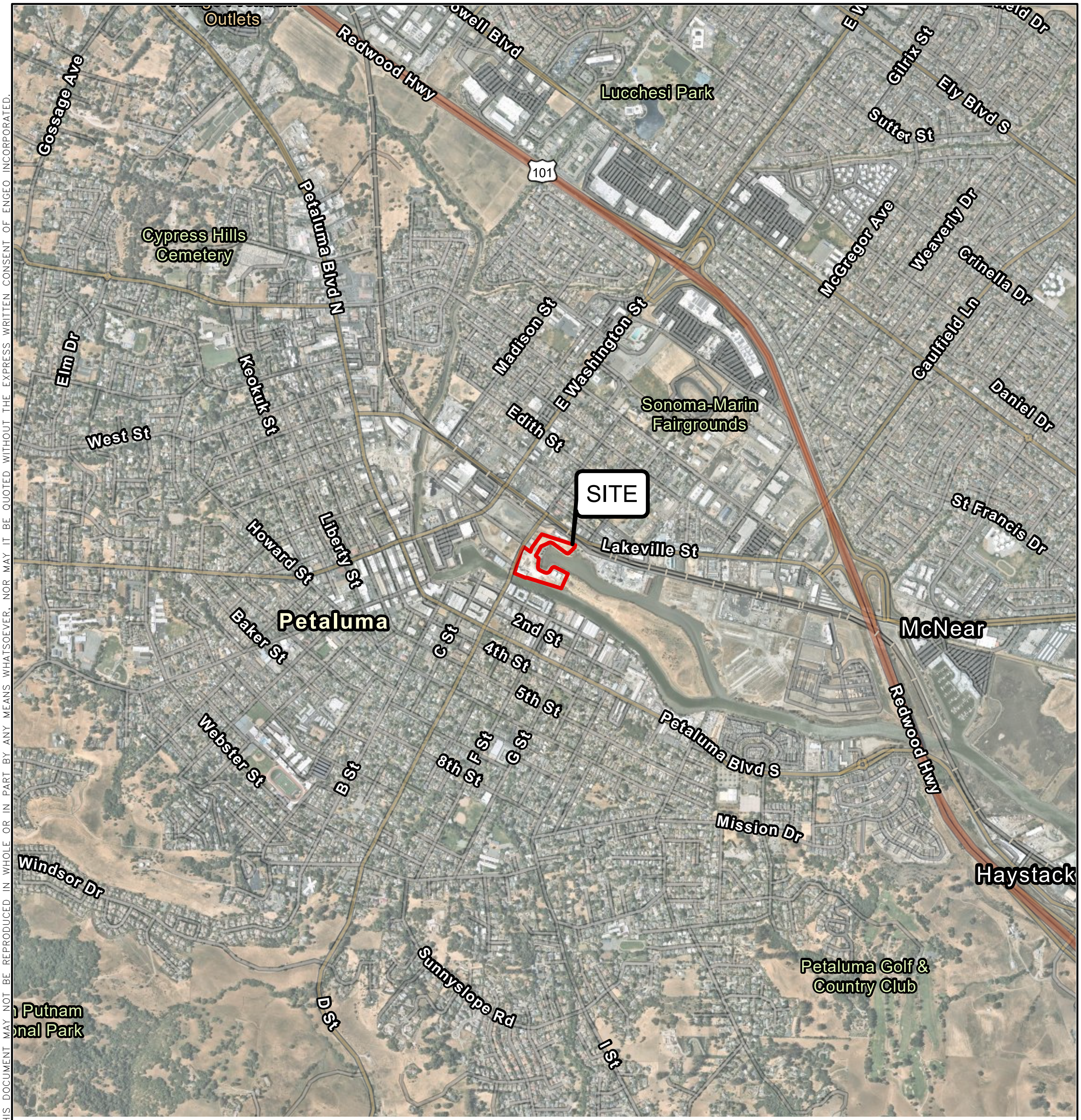
Kevin McFadden, PE

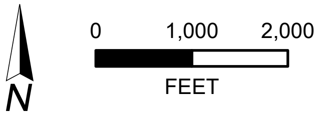
Todd Bradford, PE

Jeff Fippin, GE
km/ttb/jaf/jf

Attachments: Figure 1 – Vicinity Map
Figure 2 – Site Plan
Exploration Logs
Laboratory Testing
Slope Stability Analysis

FIGURES





BASEMAP SOURCE: NEARMAP MAPPING SERVICE 5/19/2021

ENGEO Expect Excellence	VICINITY MAP OYSTER COVE PETALUMA, CALIFORNIA	PROJECT NO. : 15571.001.000 SCALE: AS SHOWN DRAWN BY: QRL / CHECKED BY: TB	FIGURE NO. 1

PATH: G:\DRAFTING\PROJECTS_14000 TO 15999\15571\15571001000\GEOTECH\GEX\OYSTER COVE.APRX
LAYOUT: VICINITY USER: QLIANG

ORIGINAL FIGURE PRINTED IN COLOR

N

0 64 128

FEET

EXPLANATION

ALL LOCATIONS ARE APPROXIMATE

- PROJECT SITE
- CROSS SECTION
- CONE PENETARTION TEST (BSA, 2018)
- BORING (ENGEO, 2021)
- DIRECT PUSH SAMPLE (ENGEO, 2021)

BASEMAP SOURCE: NEARMAP MAPPING SERVICE 5/19/2021

ENGEO Expect Excellence	SITE PLAN OYSTER COVE PETALUMA, CALIFORNIA	PROJECT NO. : 15571.001.000		FIGURE NO. 2
		SCALE: AS SHOWN		
		DRAWN BY: QRL	CHECKED BY: TB	

PATH: G:\DRAFTING\PROJECTS_14000 TO 15999\15571\15571001000\GEOTECH\GEX\OYSTER COVE.APRX
LAYOUT: SITE PLAN USER: QLIANG

ORIGINAL FIGURE PRINTED IN COLOR

EXPLORATION LOGS

15571.001.000
July 19, 2021

KEY TO BORING LOGS

MAJOR TYPES			DESCRIPTION
COARSE-GRAINED SOILS MORE THAN HALF OF MAT'L LARGER THAN #200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LESS THAN 5% FINES	GW - Well graded gravels or gravel-sand mixtures GP - Poorly graded gravels or gravel-sand mixtures
		GRAVELS WITH OVER 12 % FINES	GM - Silty gravels, gravel-sand and silt mixtures GC - Clayey gravels, gravel-sand and clay mixtures
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LESS THAN 5% FINES	SW - Well graded sands, or gravelly sand mixtures SP - Poorly graded sands or gravelly sand mixtures
		SANDS WITH OVER 12 % FINES	SM - Silty sand, sand-silt mixtures SC - Clayey sand, sand-clay mixtures
FINE-GRAINED SOILS MORE THAN HALF OF MAT'L SMALLER THAN #200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50 % OR LESS		ML - Inorganic silt with low to medium plasticity CL - Inorganic clay with low to medium plasticity OL - Low plasticity organic silts and clays
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50 %		MH - Elastic silt with high plasticity CH - Fat clay with high plasticity OH - Highly plastic organic silts and clays
	HIGHLY ORGANIC SOILS		PT - Peat and other highly organic soils

For fine-grained soils with 15 to 29% retained on the #200 sieve, the words "with sand" or "with gravel" (whichever is predominant) are added to the group name.

For fine-grained soil with >30% retained on the #200 sieve, the words "sandy" or "gravelly" (whichever is predominant) are added to the group name.

GRAINS SIZES

U.S. STANDARD SERIES SIEVE SIZE: 200, 40, 10, 4

CLEAR SQUARE SIEVE OPENINGS: 3/4 ", 3", 12"

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

RELATIVE DENSITY

SANDS AND GRAVELS	BLOWS/FOOT (S.P.T.)
VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

CONSISTENCY

SILTS AND CLAYS	STRENGTH*
VERY SOFT	0-1/4
SOFT	1/4-1/2
MEDIUM STIFF	1/2-1
STIFF	1-2
VERY STIFF	2-4
HARD	OVER 4

SAMPLER SYMBOLS

- Modified California (3" O.D.) sampler
- California (2.5" O.D.) sampler
- S.P.T. - Split spoon sampler
- Shelby Tube
- Dames and Moore Piston
- Continuous Core
- Bag Samples
- Grab Samples
- NR No Recovery

MOISTURE CONDITION

DRY	Dusty, dry to touch
MOIST	Damp but no visible water
WET	Visible freewater

LINE TYPES

- ________ Solid - Layer Break
- _ _ _ _ _ _ Dashed - Gradational or approximate layer break

GROUND-WATER SYMBOLS

- ∇ Groundwater level during drilling
- ▼ Stabilized groundwater level

(S.P.T.) Number of blows of 140 lb. hammer falling 30" to drive a 2-inch O.D. (1-3/8 inch I.D.) sampler

* Unconfined compressive strength in tons/sq. ft., asterisk on log means determined by pocket penetrometer

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LOG OF BORING 1-B1

LATITUDE: 38.234186111 LONGITUDE: -122.633325

Geotechnical Exploration
East D street
Petaluma
15571.002.000

DATE DRILLED: 5/20/2021
HOLE DEPTH: Approx. 48 ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (WGS84): Approx. 13 ft.

LOGGED / REVIEWED BY: K. McFadden / TB
DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: SFA, Switch to Mud
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Elevation in Feet	DESCRIPTION	Blow Count/Foot	Atterberg Limits: Liquid Limit	Plastic Limit	Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Shear Strength (psf) *field approximation	Unconfined Strength (tsf) *field approximation	Strength Test Type
0	13	SANDY LEAN CLAY WITH GRAVEL (CL), reddish brown, dry, medium plasticity, rounded gravel, trace organics [FILL]										
	10											
5			20									
6		CLAYEY SAND (SC), reddish brown, loose, moist, subangular [NATIVE]										
7.5	5	LEAN CLAY (CL), brown, stiff, moist, medium plasticity	13								2.5*	PP
9		POORLY GRADED SAND (SP), reddish brown, loose, moist										
10		FAT CLAY (CH), dark gray, soft, moist, high plasticity [YBM]	3									
	0											
15				119	37	82				738		LVS
										60*	0.25*	PP+TV
			1									
17.5	-5	POORLY GRADED SAND WITH CLAY (SP-SC), dark gray, loose, moist										
20			13									
		Dense	33				14					
	-10											
24		SANDY LEAN CLAY (CL), brown light gray, stiff, moist, iron oxide staining, blocky										
25												

LOG OF BORING 1-B1

ENGEO
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LATITUDE: 38.234186111 LONGITUDE: -122.633325

Geotechnical Exploration
East D street
Petaluma
15571.002.000

DATE DRILLED: 5/20/2021
HOLE DEPTH: Approx. 48 ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (WGS84): Approx. 13 ft.

LOGGED / REVIEWED BY: K. McFadden / TB
DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: SFA, Switch to Mud
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Elevation in Feet	DESCRIPTION	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Shear Strength (psf) *field approximation	Unconfined Strength (tsf) *field approximation	Strength Test Type
	-15	SANDY LEAN CLAY (CL), brown light gray, stiff, moist, iron oxide staining, blocky										
30			16					25.7	101.6	961.6		UU
	-20											
35		Yellowish brown, hard	87								4.5+*	PP
	-25	LEAN CLAY (CL), yellowish brown, hard, moist, trace subangular gravel										
40			45									
	-30											
45		Gray and reddish brown, iron oxide staining	50 for 4"					27.5	96.5	5038.9		UU
			64									
	-35	Boring terminated at 48 feet beneath ground surface. Groundwater not observed due to drilling method.										

LOG OF BORING 1-B1A

LATITUDE: 38.234186111 LONGITUDE: -122.633325

Geotechnical Exploration
East D street
Petaluma
15571.002.000

DATE DRILLED: 5/20/2021
HOLE DEPTH: Approx. 15½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (WGS84): Approx. 13 ft.

LOGGED / REVIEWED BY: K. McFadden / TB
DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid Flight Auger
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Elevation in Feet	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Shear Strength (psf) *field approximation	Unconfined Strength (tsf) *field approximation	Strength Test Type
0–10.5	13–2.5			NR											
10.5–11.5	2.5–1.5		SANDY LEAN CLAY (CL), reddish brown, moist, medium plasticity, fine sand												
11.5–15.5	1.5 to -2.5		FAT CLAY (CH), dark gray, soft, moist, high plasticity, organics (rootlets)				66	26	40						
													1233		LVS
							119	37	82		90	48.8	402.5		UU
													500*	0*	PP+TV

Boring terminated at 15.5 feet beneath ground surface.
Groundwater not encountered.

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LOG OF BORING 1-DP1

LATITUDE: 38.235669 LONGITUDE: -122.634519

Geotechnical Exploration
East D street
Petaluma
15571.002.000

DATE DRILLED: 5/20/2021
HOLE DEPTH: Approx. 40 ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (WGS84): Approx. 15 ft.

LOGGED / REVIEWED BY: K. McFadden / TB
DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Direct Push
HAMMER TYPE: N/A

							Atterberg Limits								
Depth in Feet	Elevation in Feet	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Liquid Limit	Plastic Limit	Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Shear Strength (psf) *field approximation	Unconfined Strength (tsf) *field approximation	Strength Test Type
				NR											
			SANDY SILT (ML), light olive gray, moist, fine-grain sand												
5	10														
			CLAYEY SAND (SC-CL), olive gray, moist, fine-grain sand												
10	5														
			CLAYEY SAND (SC), pale olive, moist, fine-grain sand												
			POORLY GRADED SAND WITH SILT (SP-SM), olive, moist, fine-grain sand												
15	0														
20	-5														
			FAT CLAY WITH SAND (CL), olive gray, moist, medium plasticity												
							59	24	35		30.3				
25	-10														

ENGEO
Expect Excellence

LOG OF BORING 1-DP1

LATITUDE: 38.235669 LONGITUDE: -122.634519

Geotechnical Exploration
East D street
Petaluma
15571.002.000

DATE DRILLED: 5/20/2021
HOLE DEPTH: Approx. 40 ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (WGS84): Approx. 15 ft.

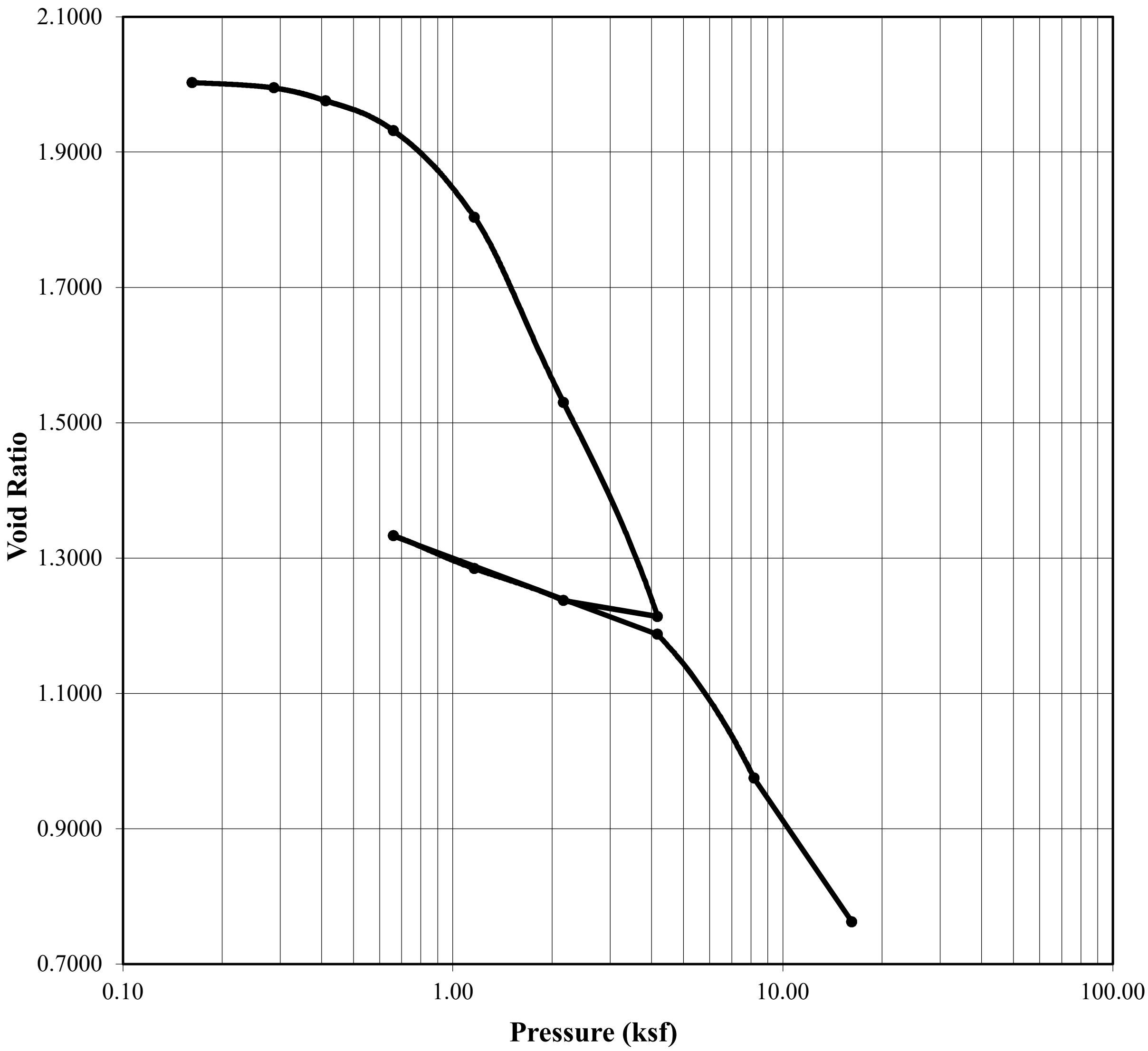
LOGGED / REVIEWED BY: K. McFadden / TB
DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Direct Push
HAMMER TYPE: N/A

Depth in Feet	Elevation in Feet	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Shear Strength (psf) *field approximation	Unconfined Strength (tsf) *field approximation	Strength Test Type
			SILT (ML), olive gray, moist, trace fine grain sand												
			Increasing sand content				36	28	8		25.7				
			CLAYEY SAND (SC), light gray, moist, fine-grain sand												
30	-15		LEAN CLAY (CL), olive gray, moist, medium plasticity												
			Pale olive												
35	-20														
			SANDY SILT (ML), olive, moist, iron oxide staining, fine-grain sand												
							36	32	4		30.3				
			POORLY GRADED SAND WITH SILT (SP-SM), pale olive, moist, fine-grain sand												
			LEAN CLAY (CL), pale olive, moist												
40	-25		Boring terminated at 40 feet beneath ground surface. Groundwater not observed due to drilling method.												

LABORATORY TESTING

15571.001.000
July 19, 2021

Incremental Consolidation
ASTM D2435 - Method B



	Before	After	ASTM D4318 - Wet Method		Test Date:	06/25/21
Moisture (%):	63.14	40.27	Liquid Limit:	n/a		
Dry Density (pcf):	54.86	79.97	Plastic Limit:	n/a		
Saturation (%):	83.08	99.99	ASTM D854 - Measured			
Void Ratio:	2.0102	0.7653	Specific Gravity:	2.646		
Soil Description:	See exploration logs		Remarks:			

Project Number:	15571.002.001 PH001	**Depth:**	13.0-15.5 fee
Sample Number:	1-B1@13-15.5	**Boring #:**	1-B1
Project Name:	East D St		
Client:	KB Home North Bay		
Location:	Petaluma, California		
Tested By: G. Criste	**Checked By:** K. Lecce		

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LABORATORY MINIATURE VANE SHEAR

ASTM D4648

APPARATUS USED: Wykeham Farrance, Model 27-WF1730/4

Sample #	Sample ID	Remold? (Y/N)	Test depth (ft)	Spring number	Shear strength (psf)
1	1-B1@15-16.5	N	16-16.25	3	738
2	1-B1A@11-13	N	12.50-12.75	4	1233

Testing remarks:

PROJECT NAME: East D St

PROJECT NUMBER: 15571.002.001 PH002

CLIENT: KB Home North Bay

ROJECT LOCATION: Petaluma, California

DATE: 06/17/21

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Tested by: G. Criste

Reviewed by: P. Galicia

MOISTURE CONTENT REPORT
ASTM D2216

SAMPLE ID	1-DP1 @24.5	1-DP1@28	1-DP1@3					
DEPTH (ft.)	24.5	28	37					
METHOD A OR B	B	B	B					
MOISTURE CONTENT (%)	30.3	25.7	30.3					

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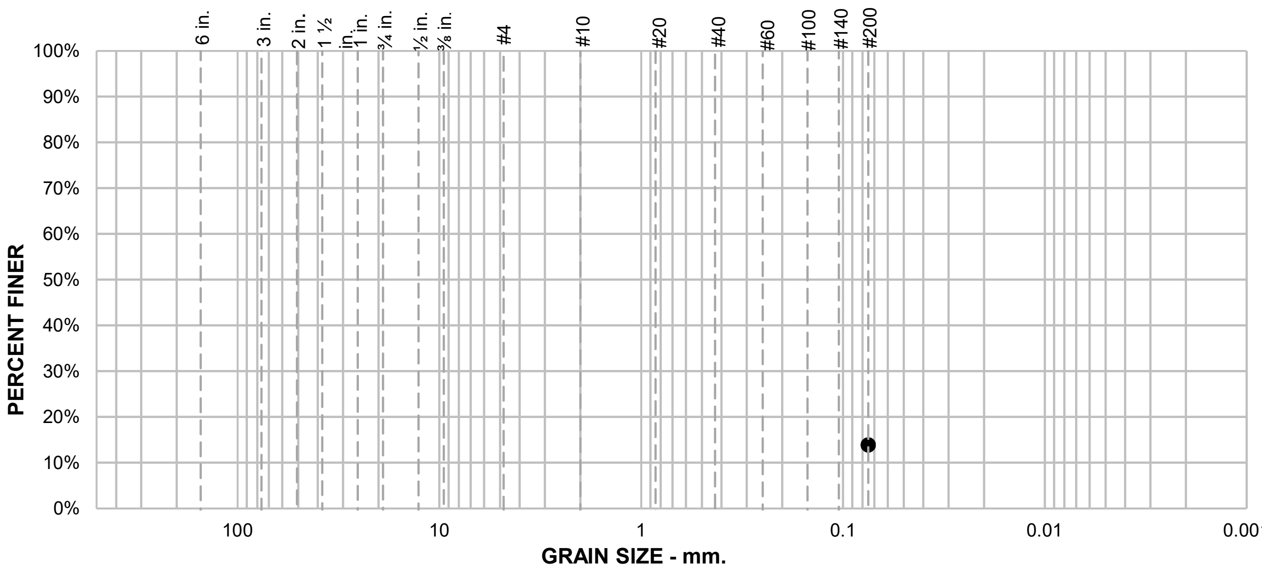
CLIENT: KB Home North Bay
PROJECT NAME: East D St
PROJECT NO: 15571.002.001 PH002
PROJECT LOCATION: Petaluma, California
REPORT DATE: 6/17/2021
TESTED BY: A. Perez
REVIEWED BY: G. Criste

PARTICLE SIZE DISTRIBUTION REPORT

ASTM D1140, Method B



SAMPLE ID: 1-B1@21.5-23

DEPTH (ft): 21.5-23

% +75mm	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
						13.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	13.9		

SOIL DESCRIPTION

See exploration logs

ATTERBERG LIMITS

PL =	LL =	PI =

COEFFICIENTS

D_{90} =	D_{85} =	D_{60} =
D_{50} =	D_{30} =	D_{15} =
D_{10} =	C_u =	C_c =

CLASSIFICATION

USCS =

REMARKS

Soak time = 180 min
Dry sample weight = 789.7 g

* (no specification provided)

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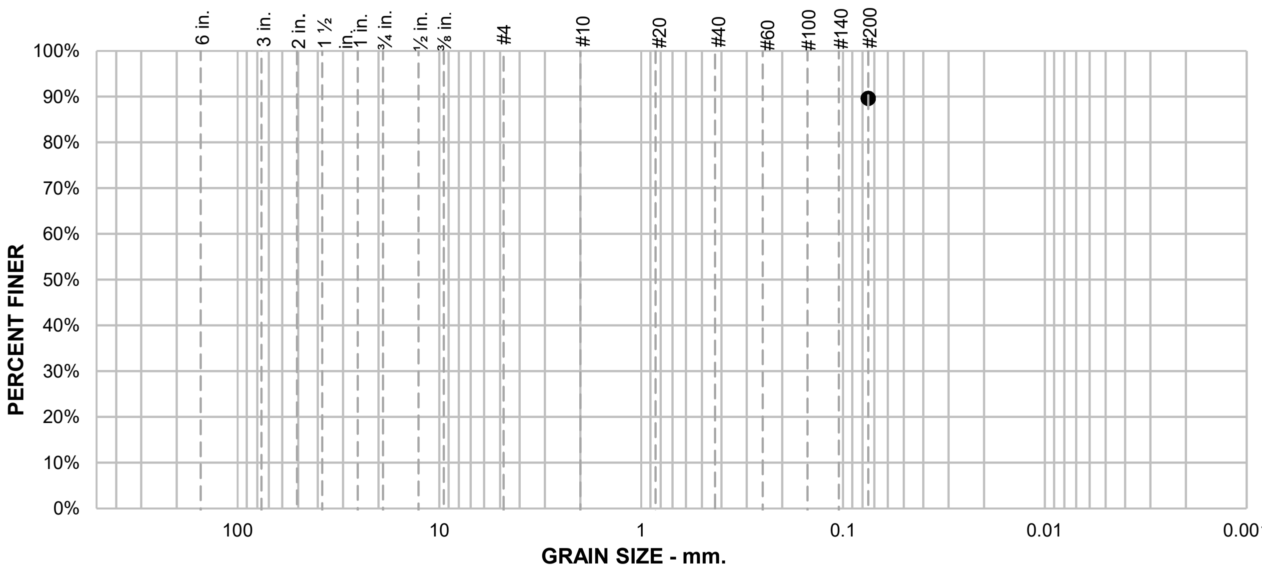
CLIENT: KB Home North Bay
PROJECT NAME: East D Street
PROJECT NO: 15571.002.001 PH002
PROJECT LOCATION: Petaluma, CA
REPORT DATE: 6/21/2021
TESTED BY: G. Criste
REVIEWED BY: M. Quasem

PARTICLE SIZE DISTRIBUTION REPORT

ASTM D1140, Method B



SAMPLE ID: 1-DP1@24.5

DEPTH (ft): 24.5

% +75mm	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
						89.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	89.6		

SOIL DESCRIPTION

See exploration logs

ATTERBERG LIMITS

PL = 24 LL = 59 PI = 35

COEFFICIENTS

D_{90} =	D_{85} =	D_{60} =
D_{50} =	D_{30} =	D_{15} =
D_{10} =	C_u =	C_c =

CLASSIFICATION

USCS = CH

REMARKS

PI: ASTM D4318, Wet Method

Soak time = 180 min
Dry sample weight = 33.27 g

* (no specification provided)

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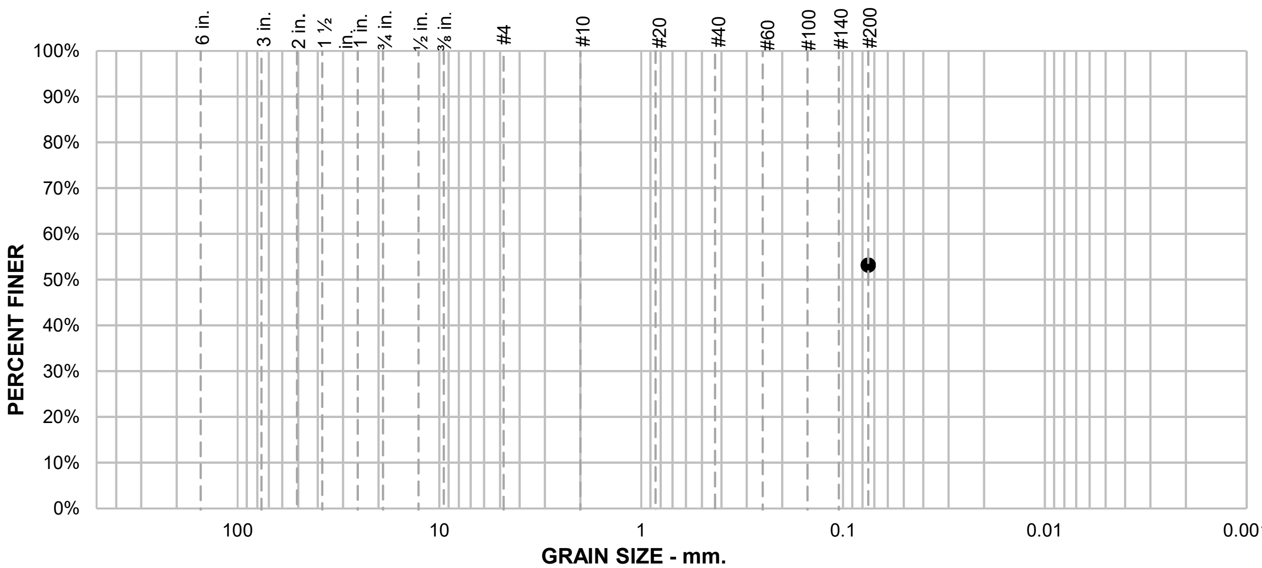
CLIENT: KB Home North Bay
PROJECT NAME: East D Street
PROJECT NO: 15571.002.001 PH002
PROJECT LOCATION: Petaluma, CA
REPORT DATE: 6/21/2021
TESTED BY: G. Criste
REVIEWED BY: M. Quasem

PARTICLE SIZE DISTRIBUTION REPORT

ASTM D1140, Method B



SAMPLE ID: 1-DP1@28

DEPTH (ft): 28

% +75mm	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
						53.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	53.2		

SOIL DESCRIPTION

See exploration logs

ATTERBERG LIMITS

PL = 28 LL = 36 PI = 8

COEFFICIENTS

D_{90} =	D_{85} =	D_{60} =
D_{50} =	D_{30} =	D_{15} =
D_{10} =	C_u =	C_c =

CLASSIFICATION

USCS = ML

REMARKS

PI: ASTM D4318, Wet Method

Soak time = 180 min
Dry sample weight = 31.22 g

* (no specification provided)

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CLIENT: KB Home North Bay

PROJECT NAME: East D Street

PROJECT NO: 15571.002.001 PH002

PROJECT LOCATION: Petaluma, CA

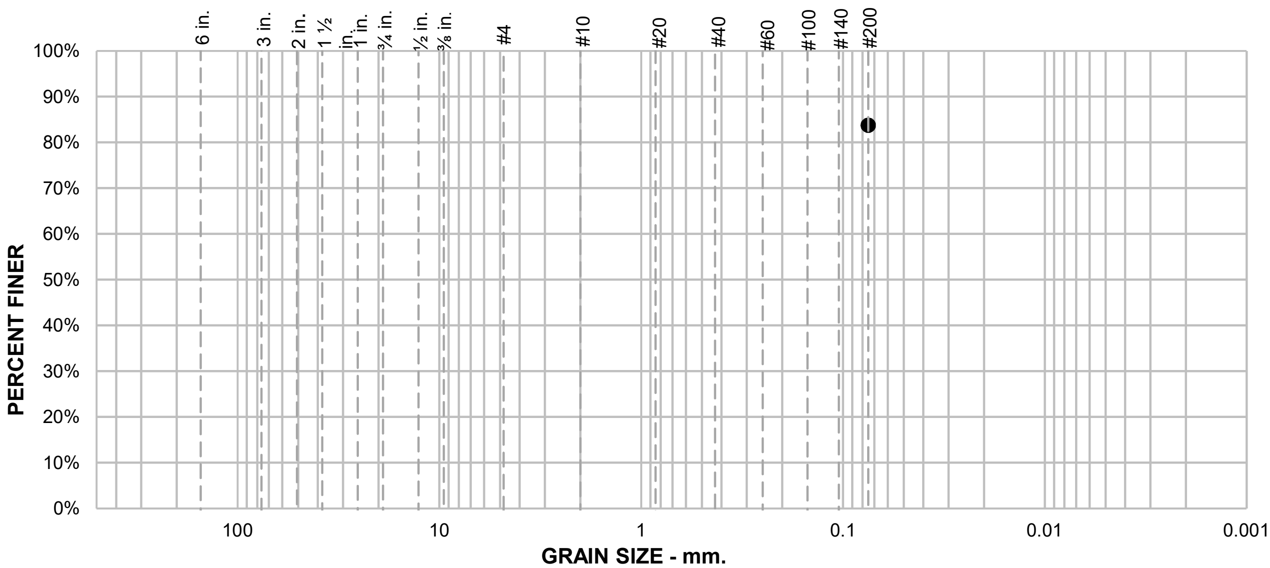
REPORT DATE: 6/21/2021

TESTED BY: G. Criste

REVIEWED BY: M. Quasem

PARTICLE SIZE DISTRIBUTION REPORT

ASTM D1140, Method B



SAMPLE ID: 1-DP1@37

DEPTH (ft): 37

% +75mm	% GRAVEL		% SAND			% FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY
						83.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	83.7		

* (no specification provided)

SOIL DESCRIPTION

See exploration logs

ATTERBERG LIMITS

PL = 32 LL = 36 PI = 4

COEFFICIENTS

D_{90} =	D_{85} =	D_{60} =
D_{50} =	D_{30} =	D_{15} =
D_{10} =	C_u =	C_c =

CLASSIFICATION

USCS = ML

REMARKS

PI: ASTM D4318, Wet Method

Soak time = 180 min
Dry sample weight = 64.23 g

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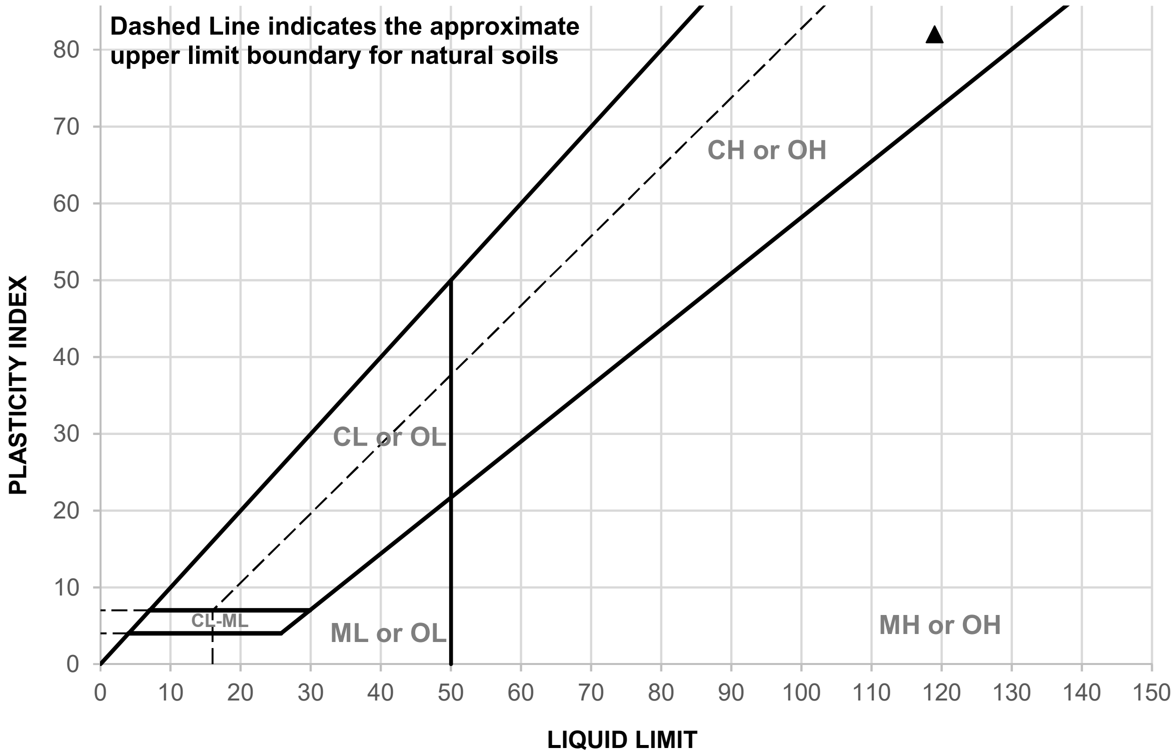
CLIENT: KB Home North Bay
PROJECT NAME: East D Street
PROJECT NO: 15571.002.001 PH002
PROJECT LOCATION: Petaluma, CA
REPORT DATE: 6/21/2021
TESTED BY: G. Criste
REVIEWED BY: M. Quasem

LIQUID AND PLASTIC LIMITS TEST REPORT
ASTM D4318



	SAMPLE ID	DEPTH	MATERIAL DESCRIPTION	LL	PL	PI
▲	1-B1@15-16.5	15-16.5 feet	See exploration logs	119	37	82

	SAMPLE ID	TEST METHOD	REMARKS
▲	1-B1@15-16.5	PI: ASTM D4318, Wet Method	

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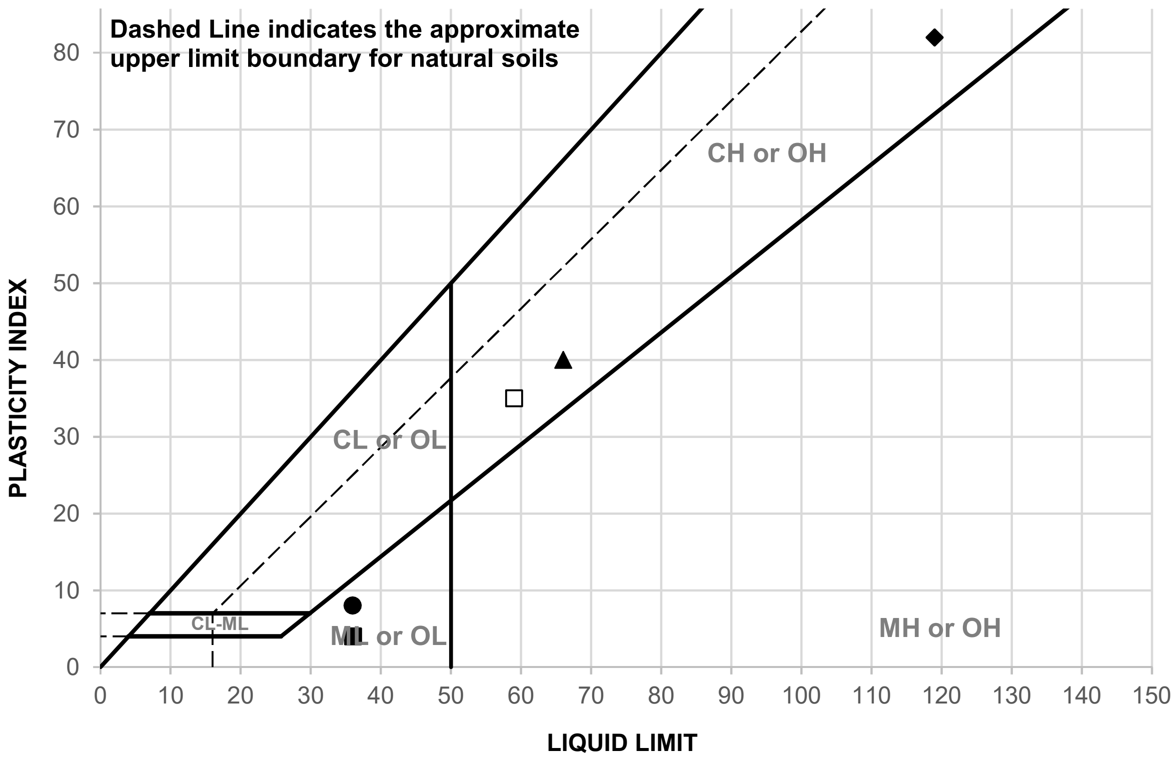
CLIENT: KB Home North Bay
PROJECT NAME: East D St
PROJECT NO: 15571.002.001 PH002
PROJECT LOCATION: Petaluma, California
REPORT DATE: 6/14/2021
TESTED BY: M. Quasem
REVIEWED BY: W. Miller

LIQUID AND PLASTIC LIMITS TEST REPORT
ASTM D4318



	SAMPLE ID	DEPTH	MATERIAL DESCRIPTION	LL	PL	PI
▲	1-B1A@11-13	11-13 feet	See exploration logs	66	26	40
◆	1-B1A@13.5-15.5	13.5-15.5 feet	See exploration logs	119	37	82
□	1-DP1@24.5	24.5 feet	See exploration logs	59	24	35
●	1-DP1@28	28 feet	See exploration log	36	28	8
■	1-DP1@37	37 feet	See exploration logs	36	32	4

	SAMPLE ID	TEST METHOD	REMARKS
▲	1-B1A@11-13	PI: ASTM D4318, Wet Method	
◆	1-B1A@13.5-15.5	PI: ASTM D4318, Wet Method	
□	1-DP1@24.5	PI: ASTM D4318, Wet Method	
●	1-DP1@28	PI: ASTM D4318, Wet Method	
■	1-DP1@37	PI: ASTM D4318, Wet Method	

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CLIENT: KB Home North Bay
PROJECT NAME: East D St
PROJECT NO: 15571.002.001 PH002
PROJECT LOCATION: Petaluma, CA
REPORT DATE: 6/21/2021
TESTED BY: M. Quasem
REVIEWED BY: W. Miller

Isotropic Unconsolidated Undrained Triaxial Test
ASTM D2850

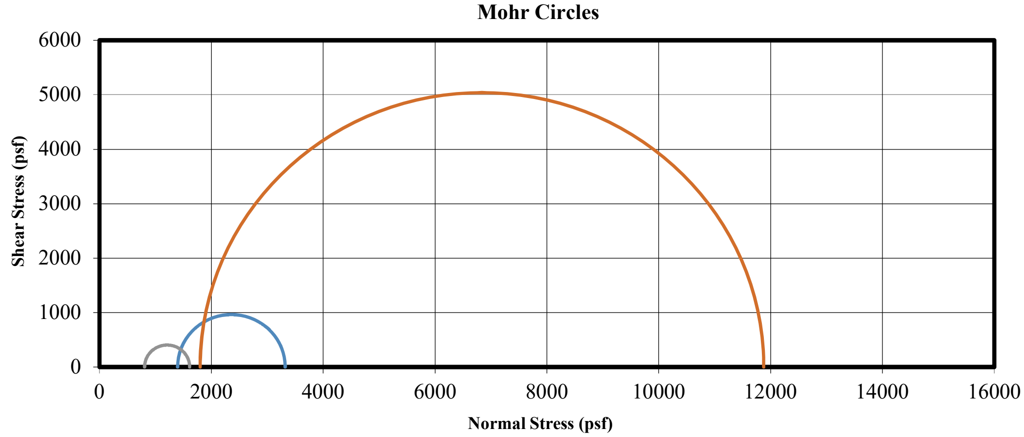
Date: 06/18/21

Checked By: K. Lecce

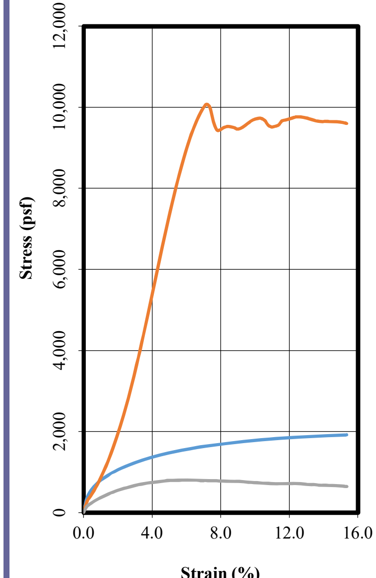
Date: 6/17/2021

Tested By: G. Criste

Mohr Circles



Stress-Strain Curve



Before Test	Specimen 1-B1@30	1-B1@45	1-B1A@13.5	
Water Content (%)	25.68	27.54	89.98	
Dry Density (pcf)	101.60	96.50	48.80	
Saturation (%)	99.94	98.71	98.70	
Void Ratio	0.72	0.76	2.48	
Diameter (in)	2.397	2.391	2.836	
Height (in)	4.990	5.019	5.939	
Height-to-Diameter Ratio	2.082	2.099	2.094	
ASTM D4318 - Wet Method				
Liquid Limit				
Plastic Limit				
ASTM D854 - Assumed				
Specific Gravity	2.795	2.720	2.720	
After Test	**1-B1@30**	**1-B1@45**	**1-B1A@13.5**	
Water Content (%)	25.68	27.54	89.98	
Saturation (%)	99.94	98.70	98.70	
Strain Rate (%/min)	0.05	0.05	0.06	
Peak Deviator Stress (psf)	1923.2	10077.8	805.0	
Axial Strain @ Failure (%)	15.341	7.173	6.230	
	Cell Pressure			
Cell (psf)	1396.8	1800.0	806.4	
Back (psf)	n/a	n/a	n/a	
	Principle Stresses at Failure			
σ1 (psf)	3320.0	11877.8	1611.4	
σ3 (psf)	1396.8	1800.0	806.4	
Corrected Peak Deviator Stress				

Mohr-Coulomb Parameters with a Non-zero Friction Angle (Ø≠0)			Cohesion at Failure with a Zero Friction Angle (Ø=0)			
Cohesion, c (psf)	n/a		961.6	5038.9	402.5	
Friction Angle Ø	n/a		n/a	n/a	n/a	

Project Information	
Project Name:	East D St
Project Number:	15571.002.001 PH002
Project Location:	Petaluma, California
Client:	KB Home North Bay
Description:	See exploration logs
Test Remarks:	

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Isotropic Unconsolidated Undrained Triaxial Test
ASTM D2850

Tested By: G. Criste Date: 6/17/2021 Checked By: K. Lecce Date: 06/18/21

SPECIMEN PHOTOS

SAMPLE NUMBER: 1-B1@30	SAMPLE NUMBER: 1-B1@45
	
SAMPLE NUMBER: 1-B1A@13.5	
	

Project Information	
Project Name:	East D St
Project Number:	15571.002.001 PH002
Project Location:	Petaluma, California
Client:	KB Home North Bay
Description:	See exploration logs
Test Remarks:	

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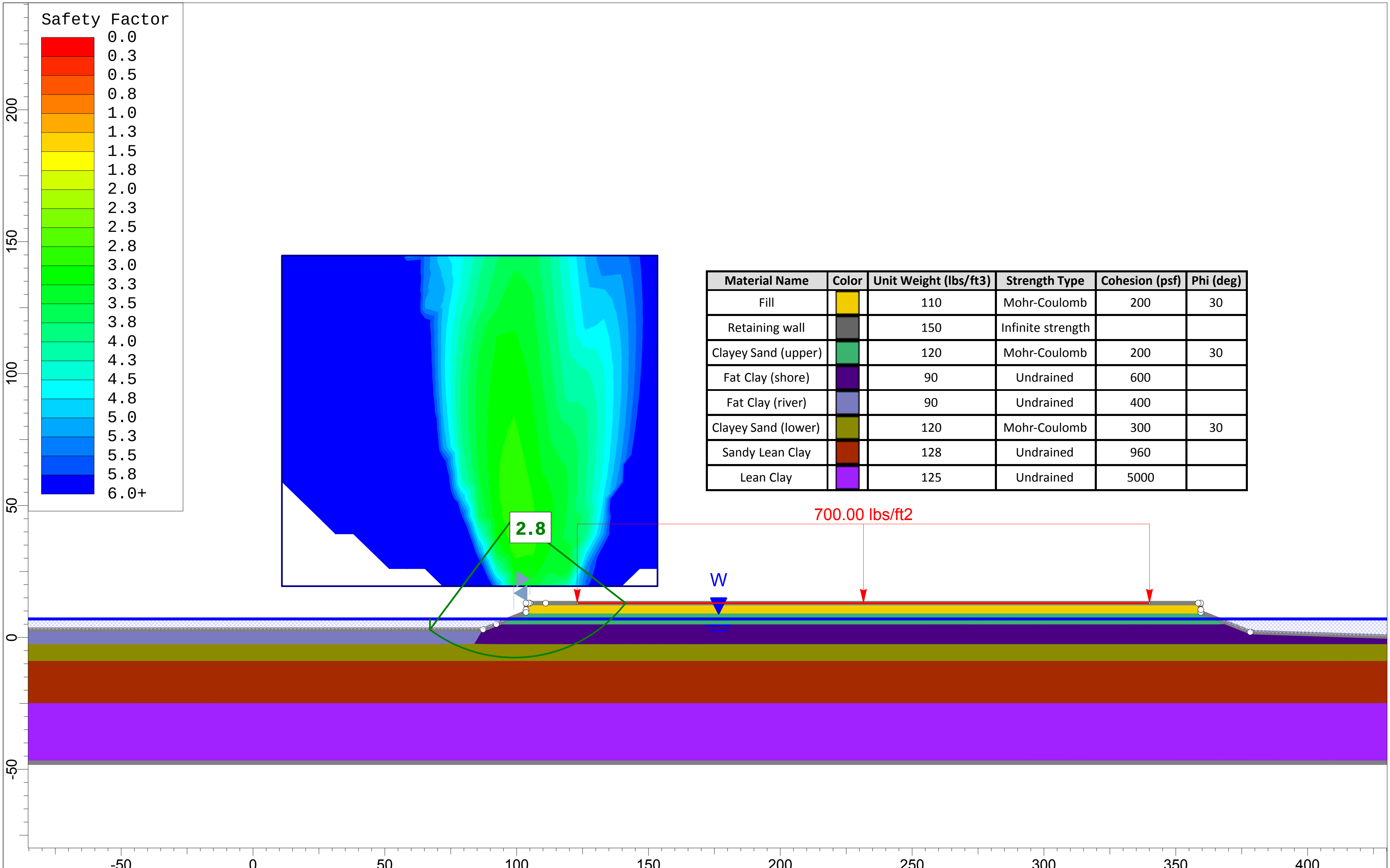
SLOPE STABILITY ANALYSIS

15571.001.000
July 19, 2021



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill		110	Mohr-Coulomb	200	30
Retaining wall		150	Infinite strength		
Clayey Sand (upper)		120	Mohr-Coulomb	200	30
Fat Clay (shore)		90	Undrained	600	
Fat Clay (river)		90	Undrained	400	
Clayey Sand (lower)		120	Mohr-Coulomb	300	30
Sandy Lean Clay		128	Undrained	960	
Lean Clay		125	Undrained	5000	

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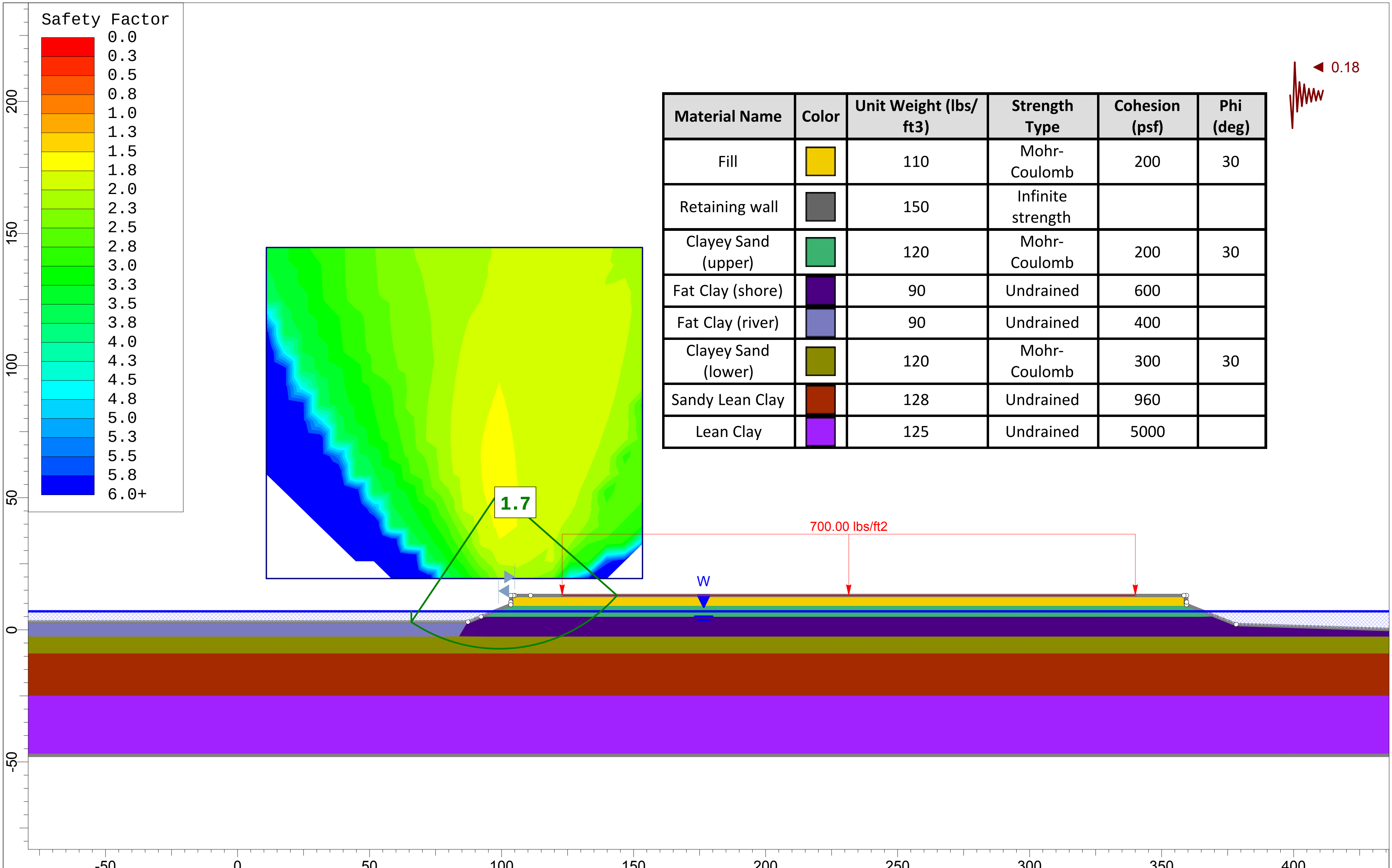
SLIDEINTERPRET 9.012

Project	Oyster Cove Section A-A'		
Scale	1:600	*Author*	AP/KM/TB
Date	7/19/2021	*Condition*	Static
Project No.	15571.001.000		



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Fill		110	Mohr-Coulomb	200	30
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Clayey Sand (lower)		120	Mohr-Coulomb	300	30
Sandy Lean Clay		128	Undrained	960	
Lean Clay		125	Undrained	5000	

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SLIDEINTERPRET 9.012

Project	Oyster Cove Section A-A'
Scale	1:600
Author	AP/KM/TB
Project No.	15571.001.000
Date	7/19/2021
Condition	Seismic