GEOTECHNICAL INVESTIGATION
Proposed Residence
15^{th} Street & East Avenue
(APN 037-015-090)
Montara, California

PREPARED FOR:

Mr. Paul McGregor
McGregor Construction
168 West Point Avenue
Half Moon Bay, California

PREPARED BY:

Buckley Engineering Associates, Inc.
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May 9, 2014

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May 9, 2014
Job #14484.10

Mr. Paul McGregor
McGregor Construction
168 West Point Avenue
Half Moon Bay, CA 94019

RE: GEOTECHNICAL INVESTIGATION
Proposed Residence
15th Street and East Avenue
(APN 037-015-090)
Montara, California

Dear Mr. McGregor:

INTRODUCTION

As authorized by our 4-25-14 agreement, we have completed a geotechnical investigation of the subject property, located on the west side of the future extension of East Avenue at the intersection with the 15th Street right-of-way in Montara, California. (Vicinity Map, Plate 1).

The purpose of this investigation was to characterize the site soils and bedrock in order to provide geotechnical design parameters for construction of a two-story, wood frame, residence. Investigation of the proposed new street areas was not included in our scope of work.

The scope of work undertaken for this study included: 1) Review of pertinent geotechnical information; 2) Site reconnaissance and subsurface exploration; 3) Laboratory testing and 4) Geotechnical engineering analysis.

GEOLOGIC SETTING

The site is located near a contact between unconsolidated sediments of the marine terrace and Montara Mountain granitic rocks (Pampeyan, 1994). The basement rocks are described as consisting of medium- to coarsely crystalline, foliated granitic rock, which is highly fractured and deeply weathered. An un-named, inactive fault passes close to the building site.

The nearest active faults include the San Gregorio/Seal Cove Fault, approximately 0.6 miles southwest of the site and the San Andreas Fault, about 6.4 miles to the northeast and the Hayward Fault, mapped on the western margin of the East Bay Hills. These faults have been sources for several strong earthquakes in the historic past. In addition, the Working Group (2008) predicted that there is a 63 percent chance of a magnitude 6.7 or greater earthquake on one or more of the major Bay Area faults within the next 30 years.

GEOLOGIC HAZARDS

Since no mapped active faults pass through the site, it is our opinion that the probability of fault rupture affecting the site is low. Since dense terrace deposits and weathered granitic rock underlie the site, the probability that liquefaction will affect the building during earthquakes is also low. Because of the site's moderate topography and strong soil, the probability of landslides affecting the project is low.

On the basis of the historical seismic record in the Bay Area, it is reasonable to assume that the proposed building will be subject to moderate to severe earthquake shaking during the lifetime of the proposed structure. The earthquake-shaking hazard can be mitigated provided that Code compliant seismic design and construction is followed.

SITE CHARACTERISTICS

Surface Features

At the time of our investigation, the site was vacant and covered with natural vegetation and trees. The property slopes moderately to the southwest and contains sufficient relief to be well drained.

Exploration Method

Two borings were drilled on the site with a portable MinuteMan drill rig to depths of 6 and 7 feet. Both borings encountered refusal in weathered granitic rock or dense terrace deposits.

The borings were advanced utilizing a continuous drive sample technique. In the borings, 3-inch, 2.5-inch and 2-inch O.D. split-barrel samplers were driven consecutively in 2-foot intervals to achieve the total depths. A 140-pound hammer supported by a portable tri-pod drove the samplers.

After correcting for the larger diameter samplers, Standard penetration resistance was tabulated for the middle 12 inches of each interval driven. The earth materials were continuously logged and sampled by our geologist. The logs of the borings showing the results of our laboratory water content, as well as the standard penetration blow-counts are contained on Plates 3 & 4. Plate 5 is the Key to the Boring Logs. Detailed results of the laboratory tests are contained Appendix A.

Subsurface Conditions

The borings encountered 2 to 3 feet of brown, firm to stiff, sandy clay, underlain by brown, dense, clayey sand (weathered granitic rock or terrace deposits) to the maximum depth explored of 7 feet.

According to the laboratory tests, the surface soil exhibits low plasticity and expansion potential (Plasticity Index = 13).

We did not encounter ground water seepage in the borings. The amount of near-surface seepage and level of the ground water can, however, vary with changes in annual rainfall and from season to season.

CONCLUSIONS AND RECOMMENDATIONS

In our opinion, the site is suitable for the proposed improvements provided the recommendations contained in this report are followed. The soils encountered in the borings provide good foundation support for the proposed structures. The primary geotechnical considerations are strong seismic shaking during a future earthquake and control of site drainage.

Due to the moderate slope and seismic setting, we recommend that the residence be supported on a pier and grade beam foundation. In order to prevent seepage of water into the crawl space, we recommend that a foundation drain be installed around the uphill perimeter of the structure.

Seismic Design

Utilizing a Site Class C, the project structural engineer should determine the seismic parameters to be used with the 2013 California Building Code.

Erosion Control

During rainy season construction, barren soil surfaces should be protected from erosive runoff. Silt should not be allowed to migrate onto neighboring properties.

Site Preparation, Grading and Compaction

Areas to be developed should be stripped of all vegetation and organic material. Stripping depths should be determined in the field at the time of construction, but for planning purposes an average stripping depth of 4 inches may be assumed. Organic strippings may be stockpiled for subsequent use in landscaping. The resulting subgrade should be scarified to a depth of 6 inches and compacted to at least 90 percent relative compaction.

If engineered fill is planned for the building pad should be supported by a base key at least 10 feet wide and sloping at a 2 percent gradient into the natural slope. The heel of the key should contain a subdrain consisting of a 4-inch diameter perforated PVC Schedule 40 or equivalent strength pipe surrounded by a prism of Class 2 Permeable Material. As the level of the fill rises, it should be benched into competent native soil until the pad grade is reached.

Engineered fill for the building pad or the driveway subgrade should be compacted to at least 90 percent relative compaction, based on ASTM D1557, latest edition laboratory compaction test procedure. Aggregate base placed in the driveway should be compacted to at least 95 percent relative compaction. Any other imported fill should be non-expansive, having a Plasticity Index of 12 or less.

Foundation

The proposed residence should be supported on drilled, caste-in-place, reinforced concrete piers deriving skin frictional support from the underlying soil and weathered rock. The piers should be at least 12 inches in diameter and extend at least 10 feet deep. We recommend that a vertical skin friction value of 400 pounds per square foot starting at a depth of 2 feet below the ground surface be used in design. The skin friction value may be increased by 1/3 to account for wind and seismic loads.

On the basis of the design loads, the project structural engineer should determine pier reinforcement.

End bearing of piers should be neglected due to the difficulty of cleaning out small diameter pier holes. Although the piers are designed for frictional resistance, care should be exercised to keep pier holes free of debris, loose cuttings and fall-in prior to placing reinforcing steel and concrete.

During pier drilling, the contractor should be prepared for the possibility of encountering ground water seepage. Ground water pumping, the tremie method or drilling and pouring concrete simultaneously are common methods used when pier drilling in high ground water or perched water conditions.

Resistance to lateral loads may be provided by passive pressure equivalent to a fluid weighing 400 pounds per cubic foot (pcf), beginning at a depth of 2 feet and acting over 1.5 pier diameters.

Slabs-On-Grade

All loose fill and topsoil should be removed from interior, exterior and garage slab areas. After this work is done, the slabs may be supported directly on compacted fill or prepared natural soil. Where migration of water vapor would be detrimental, an impermeable vapor barrier, 15-mil Stego Wrap or better should be provided between the gravel and the slab. It may be prudent to place an additional 2 inches of sand over the membrane to protect it during construction. Slabs should be reinforced with at least No. 3 bars at 18-inch centers, both ways, and be provided with control joints to reduce cracking.

Retaining Walls

Retaining wall foundations can be designed using the same parameters given above under "Foundations."

Retaining walls supporting level backfill should be designed to resist an active earth pressure equivalent to a fluid weighing 40 pcf and 65 pounds per cubic foot for a backfill sloping at 2:1 (H:V). Values for backfill sloping between horizontal and 2:1 may be calculated on the basis of straight-line interpolation. Any wall that is restrained from rotation should be designed to resist an additional uniform pressure of 100 psf. One-half or one-third of any surcharge pressure for restrained and un-restrained walls, respectively, should be considered to act on the top portion of the wall.

Also, where deemed applicable by the project structural engineer, retaining walls should be designed for a seismic loading increment (in pounds per square foot) equal to 15 times the retained soil height (in feet). The seismic component can be considered as a line load acting at a point 0.5 times the wall height above the base of the wall. The seismic loading increment should be added to the static pressures given above. When considering the combined effect of static and seismic loading, it is acceptable to use a factor of safety of 1.1 for overturning and sliding.

The above values assume that adequate drainage is provided behind the retaining walls to prevent the build-up of hydrostatic pressure. The back drains should consist of 4-inch diameter perforated (Schedule 40 or better) PVC pipe sloped to drain by gravity, and of clean, free-draining crushed rock or gravel. The gravel blanket should be at least 12 inches wide and extend to within 1 foot of the surface. The upper foot should be backfilled with compacted soil to minimize surface water infiltration. Drain rock should be separated from the soil by Mirafi 140N filter fabric. The perforated pipe should be connected to a 4-inch diameter solid PVC pipe, which drains by gravity to an acceptable outfall location.

A synthetic drainage mat (Miradrain or equivalent) can be used instead of the drainrock. The synthetic drainage material should be installed according to the manufacturer's specifications. If drainage mat is used behind walls, than the remainder of the backfill can be either free-draining gravel or compacted structural fill.

We recommend that the ground surface behind retaining walls be sloped to drain in a positive manner so that ponding and erosion do not occur. Under no circumstances should surface water be diverted into the wall back-drainage system.

Retaining walls should be thoroughly waterproofed. These retaining walls will yield slightly during backfilling; therefore, the walls should be backfilled with light equipment prior to building on or adjacent to them.

Foundation Drain

In order to intercept surface water tending to seep under the grade beam and into the crawl space, where the foundation is not supported by a drained retaining wall, we recommend that a foundation drain be constructed around the uphill perimeter of the structure. The foundation drain should be located approximately 18 inches away from the walls. It should follow the configuration of the building as much as practical and can be integrated with perimeter retaining wall subdrainage.

The subdrain should consist of a 12-inch wide trench that extends a minimum of 12 inches below the crawl space or slab elevation. The trench should slope a minimum of 2 percent from the high point(s) in the direction of the outfall(s). The soils exposed in the trench exterior should be lined also with the Mirafi filter fabric. After about 1 inch of 3/4 to 1/2-inch drain rock has been placed along the bottom of the trench, a 4-inch diameter, perforated PVC pipe should be placed (perforations down) in the bottom of the trench. Outside the building perimeter, the perforated pipe should be connected to 4-inch, solid PVC pipe placed in the trench(es) sloped to drain to erosion-protected outfall point(s). The subdrain trench should be backfilled to within 6 inches of the surface with drain rock. The filter fabric should be folded over the top of the gravel and the remainder of the subdrain trench and the entire outfall trench(es) should be backfilled with compacted on-site soil. Install Y-shaped cleanouts at 90-degree bends and at distances of 50 feet in the pipe system.

Surface Drainage

The structure should be provided with roof gutters and downspouts, connected to a solid pipe system to conduct roof water to a street or other approved discharge facility. Positive surface gradients should be provided next to the building to conduct surface water away from the foundation. Slope the soil away from the structure and compact between the foundation wall and the subdrain trench.

Periodic land maintenance may be required. Surface and subsurface drainage facilities should be checked frequently, and cleaned and maintained as necessary.

REFERENCES CITED

Pampeyan, Earl H., "Geologic Map of the Montara Mountain and San Mateo 7-1/2′ Quadrangles," 1994, Scale - 1:24,000.

Working Group on California Earthquake Probabilities, 2008, "The Uniform California Earthquake Rupture Forecast," Version 2 (UCERF 2): U.S. Geological Survey Open File Report 2007-1437.

INVESTIGATION LIMITATIONS

This report has been prepared in accordance with generally accepted geotechnical engineering principles and practices and is in accordance with the standards of practice set by the geotechnical consultants in the area. This acknowledgment is in lieu of all warranties, either expressed or implied.

This report is submitted with the understanding that it is the client's responsibility to ensure that the recommendations of this report are made known to the design professionals involved with the project; that they are incorporated into the construction drawings; and that the necessary steps are taken to see that the contractor and subcontractors carry out the recommendations in the field.

This report has been prepared for the exclusive use of Mr. Paul McGregor and his consultants for specific application to the building of a residence at 15th Street and East Avenue (APN 037-015-090) in Montara, California. In the event that there are any changes in the nature, design or location of the project or if any future additions or appurtenant structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless (1) the project changes are reviewed by us and (2) the conclusions and recommendations presented in this report are modified or verified in writing.

This report does not necessarily represent all of the information that has been communicated by us to Mr. McGregor during the course of this engagement and our rendering of professional engineering services to him. Reliance on this report by parties other than those described above must be at their own risk unless we are first consulted as to the parties' intended use of this report and only after we obtain the written consent of Mr. Paul McGregor to divulge information that may have been communicated to him.

In addition, the practice of geotechnical engineering evolves over time. Therefore, we should be consulted to update this report if construction is not performed within 12 months.

Subsurface conditions could vary between those indicated by test borings and interpreted from surface features. Therefore, a representative of this office should be retained to provide construction observation services, to observe the conditions, to modify recommendations, if necessary, and to ascertain that the project is constructed in accordance with the recommendations.

SUPPLEMENTAL SERVICES

We recommend that we review the final grading, drainage and foundation plans for conformance with the intent of our recommendations. During construction, we should observe the foundation excavations and the installation of drainage facilities to ascertain that our recommendations are followed. Upon completion of the project, we should perform a final site observation and present the results of our work in a written report.

We request that the owner inform us or the owner's representative with regard to construction scheduling. We request at least 2 days notice to allow for our scheduling and preparation. We cannot accept responsibility for items that we are not notified to observe.

The following plates are attached and complete this report:

Plate 1 - Vicinity Map
Plate 2 - Site Plan
Plates 3 & 4 - Logs of Borings
Plate 5 - Key to Logs of Borings

We appreciate the opportunity to have been of service to you. If you have any questions, please call.

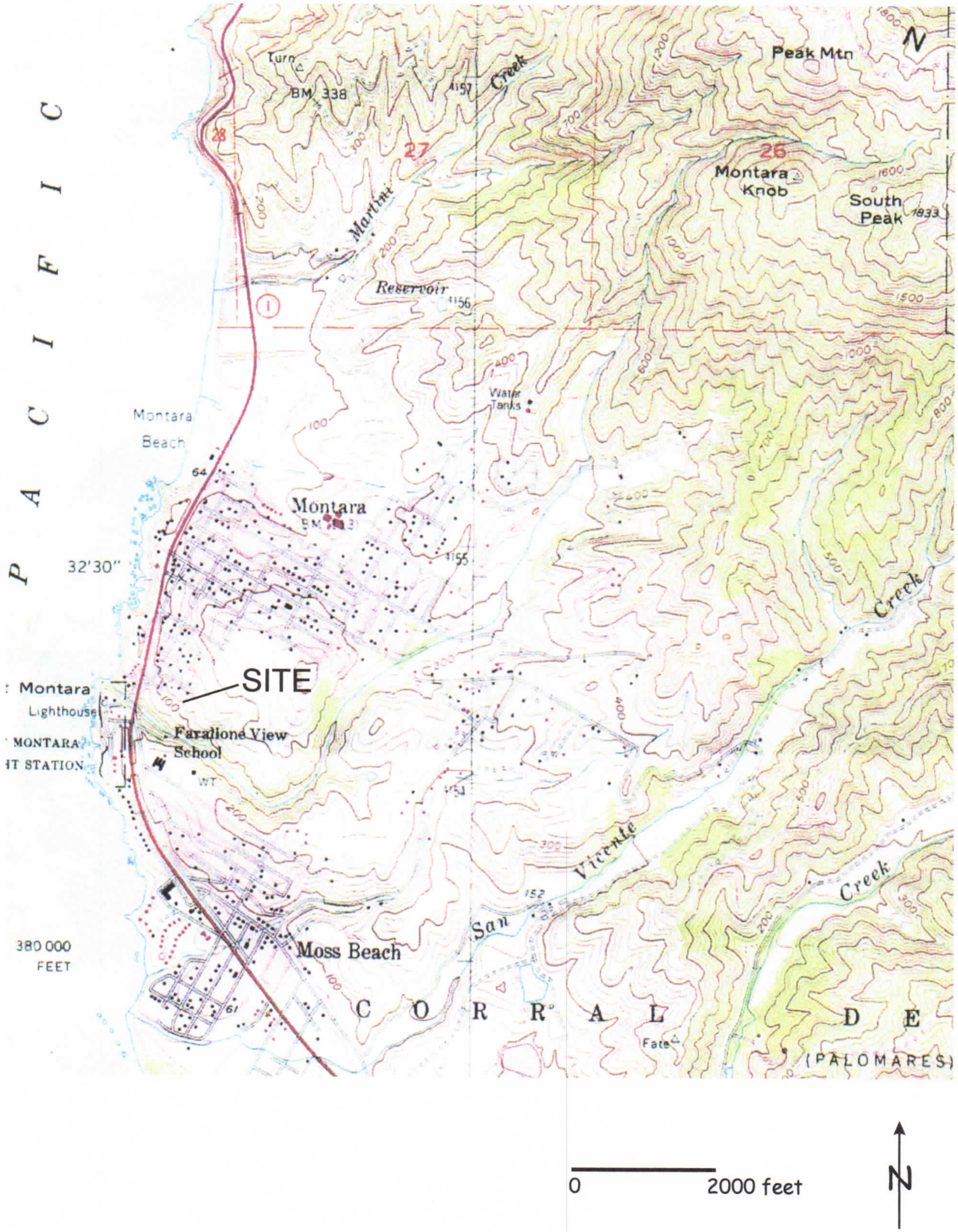
Very truly yours,

BUCKLEY ENGINEERING ASSOCIATES, INC.

David W. Buckley,
Civil Engineer 34386

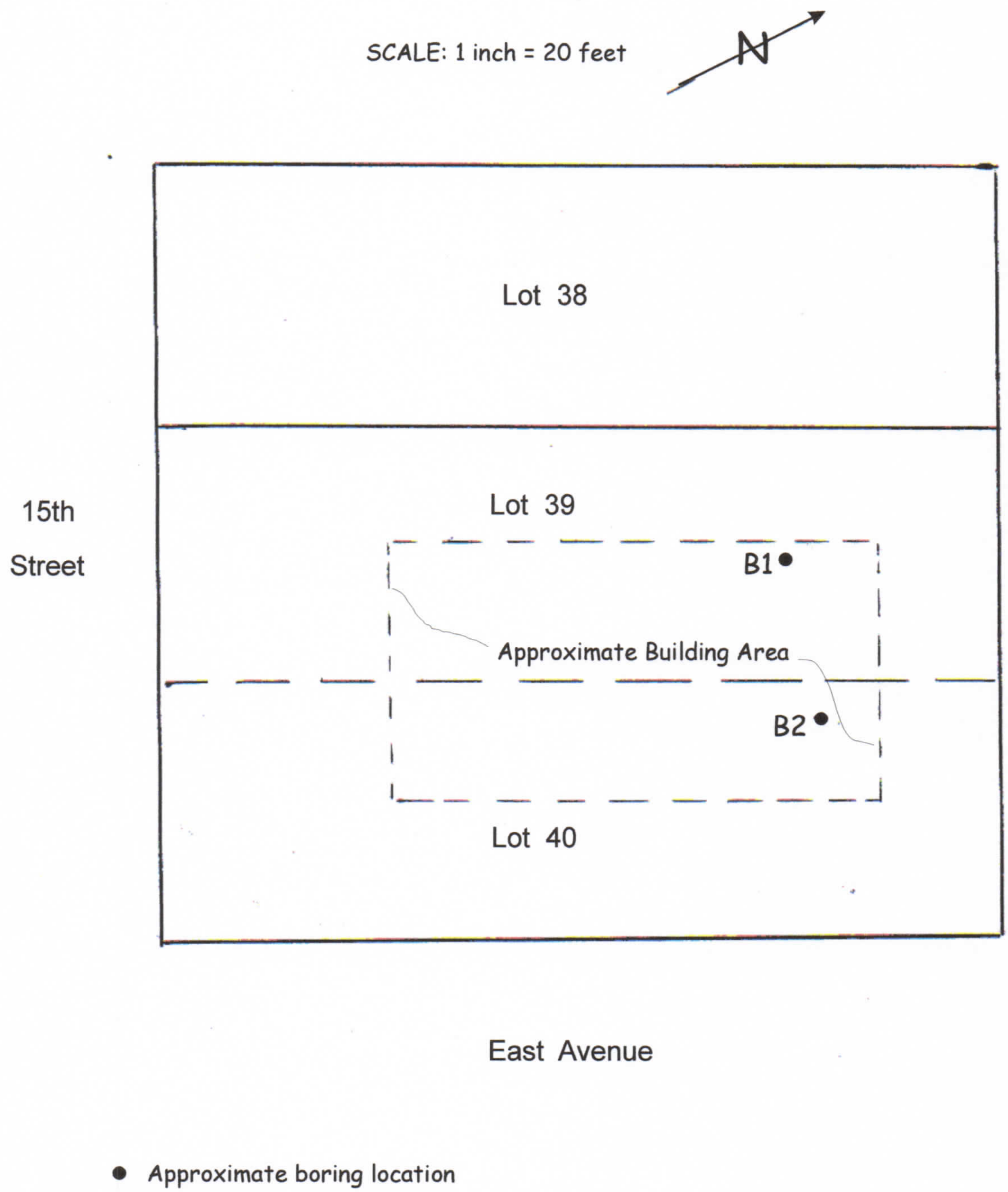
REGISTERED PROFESSIONAL ENGINEER
DAVID W. BUCKLEY
No. C34386
Exp. 9-30-15
CIVIL
STATE OF CALIFORNIA

Distribution: electronic and 3 bound copies to Mr. McGregor



From USGS 7.5 min. Montara Mountain Topographic Quadrangle, photo-revised 1980.

Buckley Engineering Associates, Inc.	Job No. 14484.10 Date 5-9-14	VICINITY MAP 15th Street & East Avenue Montara, California	Plate 1



From Survey Map by Raymond B. Thinggaard, dated September 2010.

Buckley Engineering Associates, Inc.	Job No. 14484.10 Date 5-9-14	SITE PLAN 15th Street & East Avenue Montara, California	Plate 2

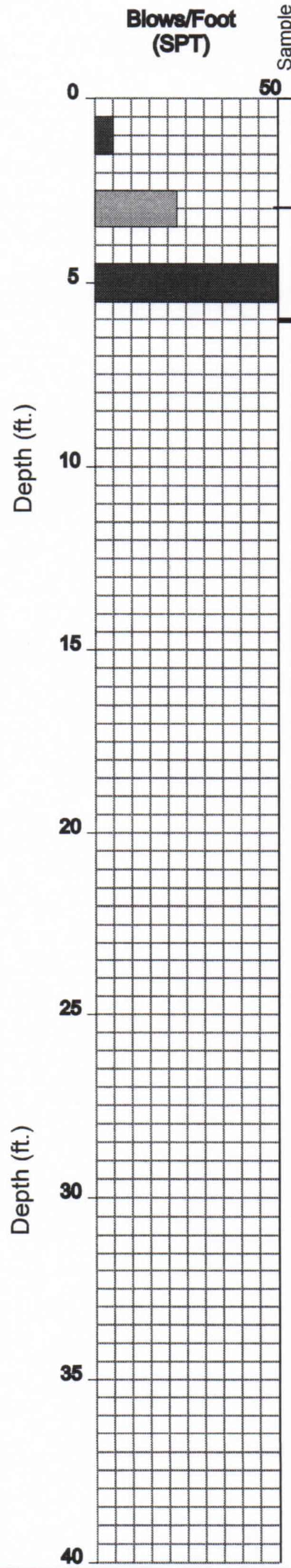
BORING B1

Equipment Portable Minute Man Rig

Elevation ---- **Date** 4-29-14

Dry Density (pcf)	Moisture Content (%)	Blows/Foot (SPT)	Depth (ft.)	USCS	Description
			0		
		5		CL	Brown, Sandy CLAY, moist, firm
					Stiff
		22			Very stiff
				Rock	Brown Clayey SAND (weathered granitic rock)
		50	5		

Refusal encountered at 6 feet.
No ground water encountered.



Buckley Engineering Associates, Inc.	Job No. 14484.10 Date 5-9–14	LOG OF BORING 15 Street & East Avenue Montara, California	Plate 3

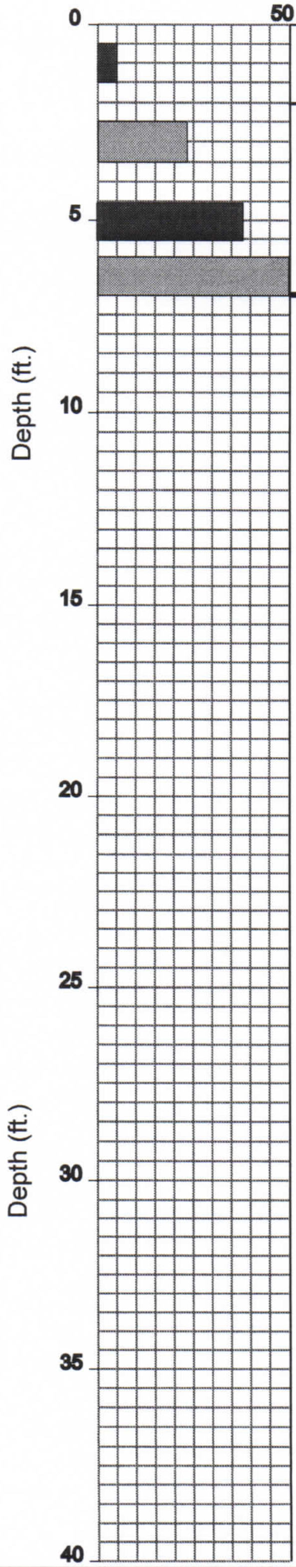
BORING B2

Equipment Portable Minute Man Rig

Elevation ---- **Date** 4-29-14

Dry Density (pcf)	Moisture Content (%)	Blows/Foot (SPT)	USCS	Description
		5	CL	Gray-brown, Sandy CLAY, moist, firm
				Stiff
		24	Rock	Brown Clayey SAND (weathered granitic rock)
		38		
	26	54		

Blows/Foot (SPT)



Refusal encountered at 7 feet.
No ground water encountered.

Buckley Engineering Associates, Inc.	Job No. 14484.10 Date 5-9-14	LOG OF BORING 15 Street & East Avenue Montara, California	Plate 4

Primary Divisions				Group Symbol	Secondary Divisions
COARSE GRAINED SOILS	MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
				GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
			GRAVEL WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
				GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
		SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	Well graded sands, gravelly sands, little or no fines.
				SP	Poorly graded sands or gravelly sands, little or no fines.
			SANDS WITH FINES	SM	Silty sands, sand-silt mixtures, non-plastic fines.
				SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS	MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT IS LESS THAN 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
				OL	Orangic silts and organic silty clays of low plasticity.
		SILTS AND CLAYS LIQUID LIMIT IS GREATER THAN 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic.
				CH	Inorganic clays of high plasticity, fat clays.
				OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS				Pt	Peat and other highly organic soils.

Definition of Terms

U.S. Standard Series Sieve — **Clear Square Sieve Openings**

	200		40	10	4		3/4"	3"	12"	
SILTS AND CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

Grain Sizes

SAND AND GRAVELS	BLOWS/FOOT*
VERY LOOSE	0 -4
LOOSE	4 -10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	OVER 50

Relative Density

SILTS AND CLAYS	STRENGTH **	BLOWS/FOOT*
VERY SOFT	0 - 1/4	0 - 2
SOFT	1/4 - 1/2	2 - 4
FIRM	1/2 - 1	4 - 8
STIFF	1 - 2	8 - 16
VERY STIFF	2 - 4	16 - 32
HARD	OVER 4	OVER 32

Consistency

* Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) split spoon (ASTM D-1586)

** Unconfined compressive strength in tons/sq. ft. as determined by laboratory testing or approximated by the standard penetration test (ASTM D-1586), pocket penetrometer, torvane, or visual observation.

■ Sample location; blow counts listed are from the bottom 12 inches of 18- inch drive sample.

Unified Soil Classification System (ASTM D-2487)

Buckley Engineering Associates, Inc.	**Job No.** 14484.10 **Date** 5-9-14	**KEY TO BORINGS** **15th Street & East Avenue** **Montara, California**	**Plate** 5

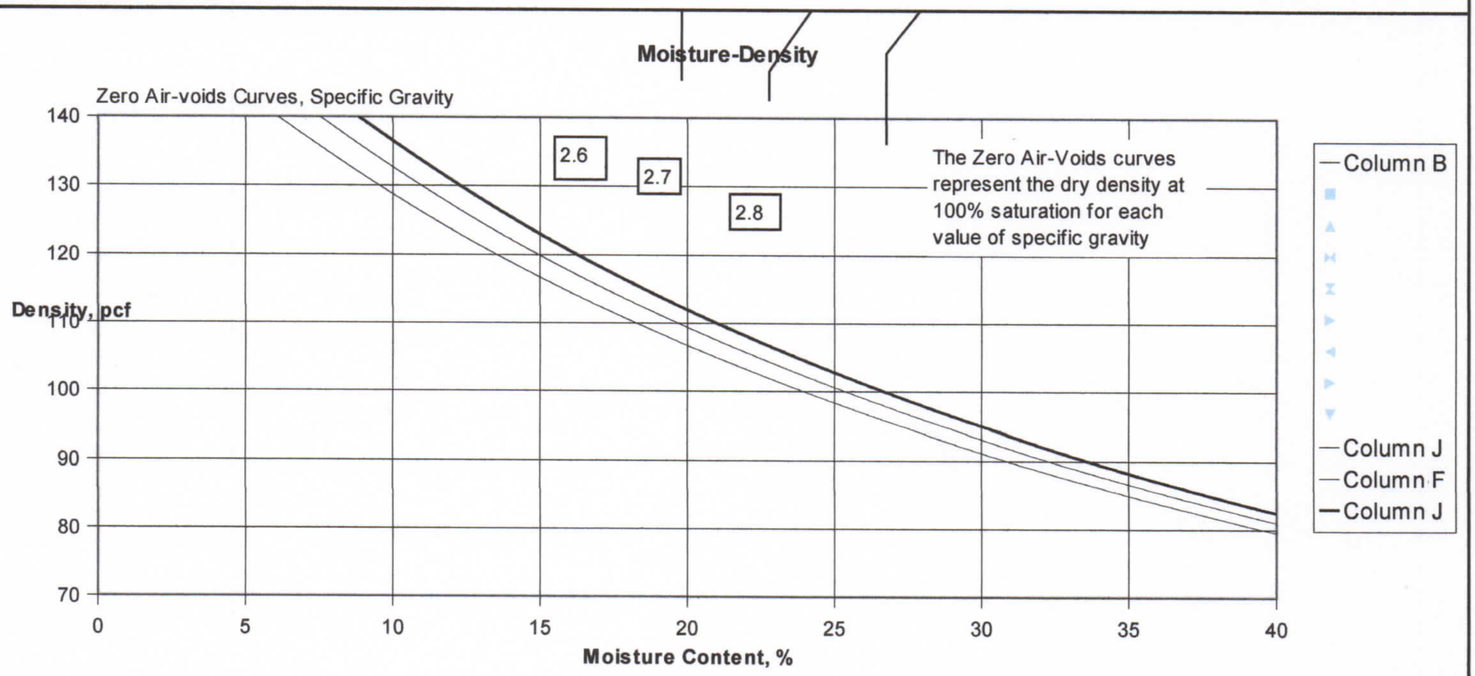
APPENDIX A
Laboratory Test Results
Cooper Testing Laboratory

Moisture-Density-Porosity Report
Cooper Testing Labs, Inc. (ASTM D 2937)

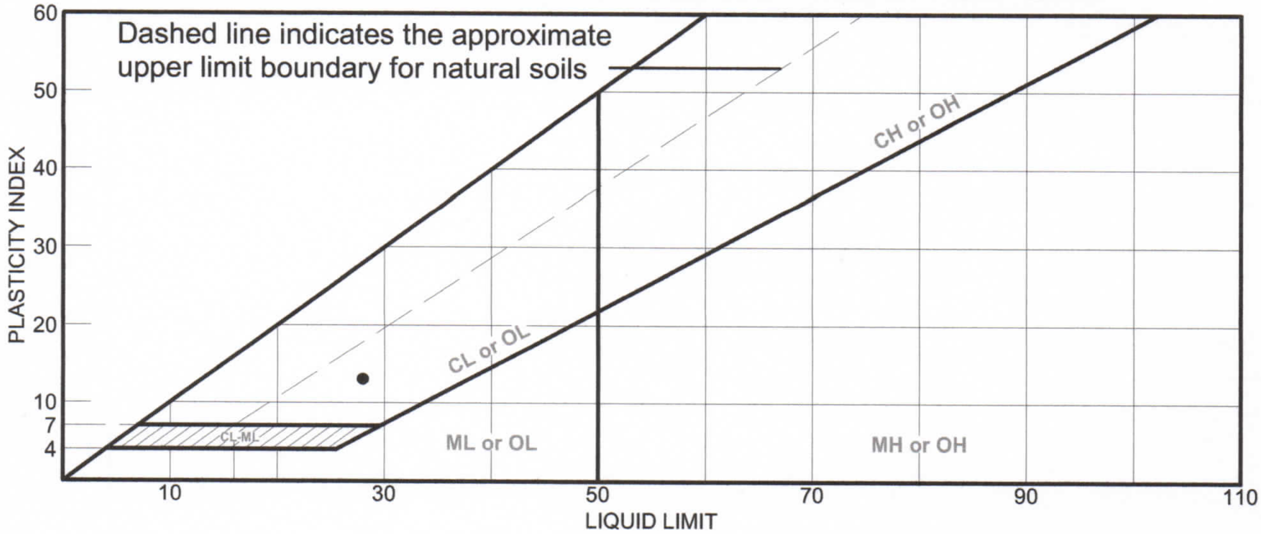
CTL Job No:	146-106	**Project No.**	14484.10	**By:**	RU
Client:	Buckley Engineering	**Date:**	05/05/14		
Project Name:	15th St. Montara	**Remarks:**			

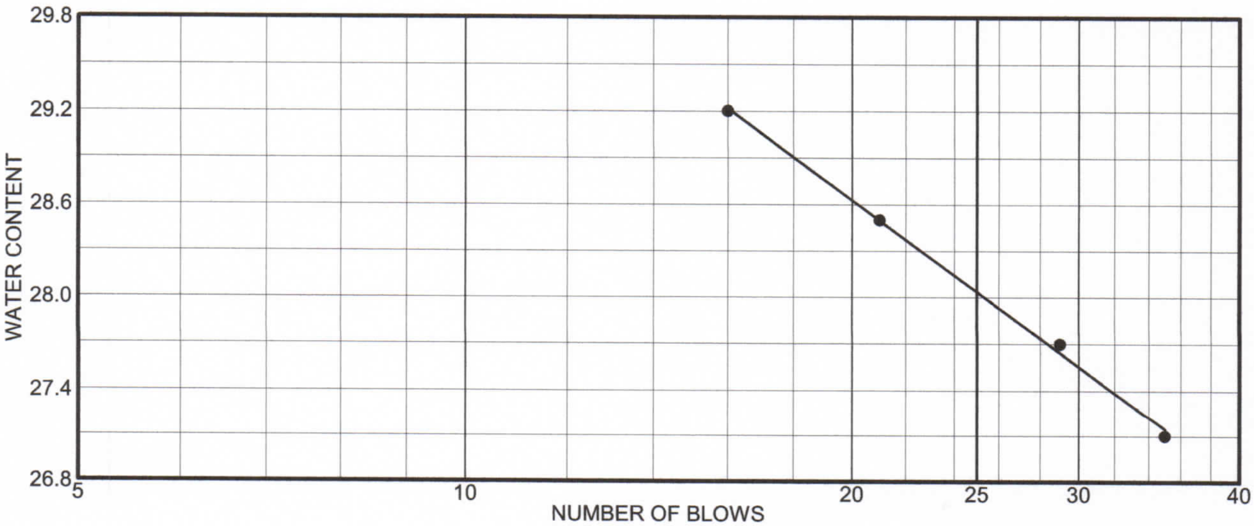
Boring:	B2							
Sample:								
Depth, ft:	5.5-7							
Visual Description:	Strong Brown Clayey SAND							
Actual G_s								
Assumed G_s								
Moisture, %	25.7							
Wet Unit wt, pcf								
Dry Unit wt, pcf								
Dry Bulk Dens.pb, (g/cc)								
Saturation, %								
Total Porosity, %								
Volumetric Water Cont,Θw								
Volumetric Air Cont., Θa								
Void Ratio								
Series	1	2	3	4	5	6	7	8

Note: All reported parameters are from the as-received sample condition unless otherwise noted. If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered approximate.



LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Very Dark Yellowish Brown Lean Clayey SAND	28	15	13			

Project No. 146-106 **Client:** Buckley Engineering

Project: 15th St. Montara - 14484-10

● **Source:** B1 **Elev./Depth:** 0-2'

Remarks:

●

LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

COOPER TESTING LABORATORY

#200 Sieve Wash Analysis
ASTM D 1140

Job No.:	146-106	Project No.:	14484.10	Run By:	MD
Client:	Buckley Engineering	Date:	5/7/2014	Checked By:	DC
Project:	15th St. Montara				

Boring:	B1								
Sample:									
Depth, ft.:	0-2								
Soil Type:	Very Dark Yellowish Brown Lean Clayey SAND								
Wt of Dish & Dry Soil, gm	584.0								
Weight of Dish, gm	316.3								
Weight of Dry Soil, gm	267.7								
Wt. Ret. on #4 Sieve, gm	0.9								
Wt. Ret. on #200 Sieve, gm	155.3								
% Gravel	**0.3**								
% Sand	**57.7**								
% Silt & Clay	**42.0**								

Remarks: As an added benefit to our clients, the gravel fraction may be included in this report. Whether or not it is included is dependent upon both the technician's time available and if there is a significant enough amount of gravel. The gravel is always included in the percent retained on the #200 sieve but may not be weighed separately to determine the percentage, especially if there is only a trace amount, (5% or less).