GEOTECHNICAL INVESTIGATION

Landslide Mitigation
Lower Slope at 634 & 636 Palomar Drive
Redwood City, California

Prepared for:
Mr. and Mrs. Darius Soltanieh
724 Arastradero Road, Apt. 121
Palo Alto, California 94306

June 16, 2017
Job 2572.01.01

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Earth Investigations Consultants

June 16, 2017
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Mr. & Mrs. Darius Soltanieh
724 Arastradero Road, Apt. 121
Palo Alto, California 94306

RE: GEOTECHNICAL INVESTIGATION
Landslide Mitigation
Lower Slope at 634 & 636 Palomar Drive
Redwood City, California

Dear Mr. and Mrs. Soltanieh:

INTRODUCTION

Site Location and Proposed Project

Pursuant to your authorization, we have performed an evaluation of, and mitigation plan for, a landslide that occurred during heavy rainfall earlier this year on the slope at the lower southwest margin of your property fronted by Los Cerros Road and the intersection with Palomar Drive. The site is located in unincorporated Palomar Park of Redwood City, California (Plate 1, Vicinity Map; Plate 2, Site Plan, Cross Section A–A', and Photos 1 & 2).

The purpose of this investigation was to evaluate the landslide geometry and provide recommendations for repair. We strongly recommend you consider a design/build construction firm with experience in slope repair grading and drainage to implement the recommended mitigations presented in this report.

The scope of services undertaken to arrive at the findings, conclusions and recommendations presented in the following sections of this report included the following:

- Review of our files and pertinent regional geologic and topographic mapping. Plate 3 contains an excerpt of the geologic map covering the site area.
- Reconnaissance engineering geologic mapping onto a recent topographic map, and unmanned aerial vehicle (UAF) imagery (Plate 2);
- Drilling and sampling of 3 borings at selected locations on the landslide surface. Each boring was continuously sampled by driving California,

modified California, and Standard Penetration (SPT) split-spoon samplers with a 140-pound hammer lifted to a height of 30 inches using a rope and cathead lift mechanism mounted to a tripod (Plates A1 and A2, Appendix A).

The number of free-fall drops (blows) by the hammer required to drive the respective samplers at 6-inch depth intervals for the middle 12 inches of the 24-inch drive segments for Borings 1 and 2, and the lower 12 inches in Boring 3 are tabulated in terms of SPT values. Blow counts from driving the modified California and California sampler were converted to SPT values using a multiplier of 0.76 and 0.93, respectively. Plates A3, Key to Borings, and Plate A4, Rock Hardness Chart, provide descriptions of the terms and symbols used on the logs;

- Laboratory testing of selected samples for moisture content, dry density, particles passing the -200 sieve analysis, and Atterberg limits. The test results are tabulated on the Logs of Borings at the respective sample depths, and on Plate A5, Plasticity Chart;
- Geotechnical analysis and preparation of mitigation measures, and preparation of Plate 4 (Conceptual Mitigation Measures).

FINDINGS

The landslide involved the northeast-facing slope of two properties (636 and 634 Palomar Drive) uphill of Los Cerros Road and Palomar Drive, and covers approximately 2500 square feet (Plate 2). Plate 3 indicates the slope is underlain by tightly folded Sandstone of the Franciscan complex. Previous reconnaissance observations and subsurface exploration in the southern part of your property, where you are planning a new residential development, confirmed the hillside is underlain by generally massive Franciscan Sandstone interbedded locally with Shale.

An unimproved dirt road, coinciding with the general alignment of the poorly-drained unimproved gravel road depicted on Plate 2, was detected on 1948 Google Earth imagery. The imagery also revealed substantial reduction of vegetation (clearing?) on the lower part of the slope sometime between 1991 and 2002. A debris flow scar was detected on March 2003 imagery, and previous site topographic mapping, including the recent mapping used for the base of Plate 2, reveal concave upward deflections indicative of past, localized erosion on the lower part of the slope within, and adjacent to the mapped limits of the recent landslide.

The recent landslide depicted on Plate 2 occurred during sustained heavy rainfall this past winter. It comprises approximately 2500 square feet of moderately steep, grassy hillside between Los Cerros Road and Palomar Drive and an unimproved gravel driveway common across the neighbor's property (636 Palomar Drive) and your property (634 Palomar Drive). The surface expression of the slide reflects a retrogressive, primarily rotational failure mode (slump), and secondary translational, surficial debris slide/flow failure mode characterized by angular (serrated) source area headscarps corresponding to orientation of desiccation cracks in the upper-middle part (Plate 2, Photo 1). The headward and perimeter flanks were well-defined by generally vertical escarpments ranging from a few inches up to approximately 3 feet in height. The landslide toe apparently intersected the steep 3- to 4-foot high roadway just above the elevation of the roadway overriding a drainage gutter. Relief of the hummocky and fissured slide surface is approximately 25 feet with an average slope of 20 degrees; roughly the same as the adjoining intact native slope.

Seepage and pooled water was observed on the landslide surface in the lower part of the east flank. Saturated, highly plastic soil, probably representing the basal rupture surface, was observed at the intersection of the right flank and Palomar Drive.

The borings indicate the central part of the landslide involved up to approximately 6½ deep of colluvium and bedrock, including approximately 3 to 4 feet of high plasticity (PI=23) sandy clay with a variable content of gravel-size angular rock fragments, and the upper 2 to 3 feet of Franciscan bedrock, including weathered sandstone and sheared rock (Plate 2, Cross Section A-A' and Plates A1 and A2). Slight seepage was encountered in the upper part of sheared SANDSTONE. Standing water was measured at an approximate depth of 7½ feet upon completion of drilling.

DISCUSSION AND CONCLUSIONS

This investigation revealed the slope between Los Cerros Road/Palomar Drive has been subjected to historic surficial erosion, including possible debris flow activity in the recent landslide area. Evidence for a landslide of the magnitude of the recent event was not detected on historic aerial imagery or topographic mapping.

We interpret mechanisms of failure, from the site investigation and boring data, to include:

1. Surface infiltration of concentrated sheet flow (gully erosion was absent) from the poorly-drained, unimproved gravel roadway, and saturation of the pervasively cracked colluvial surface allowing infiltration to the top of the weathered and sheared bedrock encountered up to 6½' below the ground surface;
2. Absence of lateral slope support along the roadway cut at the toe of the slope. Relative deep desiccation cracks appear to have controlled the head and margins of the slide, and the basal rupture surface appears to coincide with the geologic contact between the colluvium and resistant bedrock.

In the following section of this report, we present mitigation measures including removal and replacement of the landslide mass with drained engineered fill supported at the toe by an engineered retaining wall, and comprehensive surface drainage improvements to the gravel roadway above the slide area.

RECOMMENDATIONS

Seismic Parameters

The recommended retaining wall should be designed for the following seismic design criteria derived from the subsurface exploration data, the 2016 California Building Code, and 2010 ASCE 7 (with March 2013 errata):

- Site Location: Latitude = 37.377; Longitude = -122.124
- Site Soil Class: C
- Spectral Response Acceleration Values (g):
  F_V = 1.3; S_S = 2.108; S_1 = 0.999; S_{DS} = 1.405; S_{D1} = 0.866

Site Preparation, Grading and Compaction

We recommend the landslide be entirely removed and replaced as drained engineered fill (Plate 4). Preliminarily, we judge temporary cut slopes to facilitate benching fill onto competent bedrock will be up to 12 feet high (at the headscarp). The height of cut slopes can be reduced by increasing the frequency of benching. In any event, it will be important for the Contractor to carefully evaluate and maintain grading safety precautions throughout the construction process.

Preliminarily, we judge temporary cuts inclined to a maximum of 1H:1V up to 10 feet high area will be possible. The cuts above 10 feet should be reclined to 1½H:1V. However, given the chaotic condition of the Franciscan rock, the actual maximum inclination should be evaluated at each bench location by the Engineering Geologist, and adjusted accordingly.

Benching to support engineered fill should be cut into bedrock or competent residual soil, as assessed by the Engineering Geologist during grading, with an approximate inclination of approximately 2 percent into the slope to facilitate subdrainage.

The toe bench, which we anticipate will span the bedrock/colluvium contact, should be cut to an approximate 2-percent out of slope gradient to direct water to the retaining wall backdrain. As assessed by the Field Engineer during grading, the exposed bench surfaces should be evaluated for scarification to a depth of at least 8 inches, moisture conditioning to near optimum, and compaction to at least 90 percent of the maximum dry density (MDD) of the materials as determined by performing the ASTM D1557 laboratory compaction curve test on representative samples of the earth material to be used in engineered fill. Once the bench surface is prepared, suitable on-site soil, as assessed by our Field Engineer, should be placed in maximum 8-inch thick loose lifts, moisture conditioned to near optimum and compacted to at least 90 percent MDD.

As fill increases up a slope, level benches should be sequentially excavated to expose competent bedrock support material. Fill should not be placed on soft soil. Therefore, the Contractor should be prepared for local overexcavation, as well as potentially hard rock conditions.

Subdrainage requirements should be assessed by the Field Engineer during grading. For planning, assume installation of a subdrain at the rear of benches, as depicted on Plate 4. But, the Field Engineer should assess the need for additional subdrainage as conditions dictate during grading.

Each subdrain should have a minimum with of 12 inches, and extend from 18 inches below the finished ground surface to the depth of the respective bench. The subdrain excavation should be faced with Mirafi 140N filter fabric prior to placement of drainage material. A minimum 4-inch diameter perforated, Schedule 40 PVC pipe should be placed onto the bottom of the trench with the holes oriented down, and inclined at least 2 percent in the direction of discharge. It may be necessary to place a few inches of clean crushed rock onto the fabric surface to establish the desired slope of the perforated pipe.

A solid, 4-inch diameter Schedule 40 PVC cleanout should be connected by sweep fitting to the upstream end of the perforated pipe to allow for future observation and maintenance of the subdrainage pipes. The subdrain alignment should be backfilled to within 2 feet of the finished surface with ¾- to 1½-inch clean crushed rock. The top of the crushed rock should be covered by filter fabric before placement of engineered fill to the adjacent ground surface.

Retaining Wall Foundation

The proposed retaining wall should be supported by minimum 24-inch diameter drilled and cast-in-place piers that extend at least 6 feet into competent bedrock, or at least 2 times the retaining wall height, whichever is greater as assessed by the Field Engineer during drilling. The piers should be designed for the following geotechnical parameters:

- Skin friction value of 400 pounds per square foot (psf) beginning at the top of the bedrock;
- Passive equivalent fluid pressure of 300 pounds per cubic foot (pcf) beginning at the bedrock surface and acting over 1½ pier diameters;

Retaining Wall Design

The retaining wall stem, to be supported by drilled piers designed in accordance to the parameters in the preceding section, should be at least 4 feet high to account for retention of 3 feet of engineered fill and 1 foot of freeboard. We recommend the wall be designed to resist an active equivalent fluid pressure of 60 pcf for compacted backfill up to a maximum slope of approximately 20 degrees.

The retaining wall should be fully backdrained. The backdrain should consist of a 4-inch diameter perforated Schedule 40 PVC pipe laid holes down and sloped approximately 2 percent to drain to outlet by gravity. The perforated pipe should be placed onto Mirafi 140N filter fabric approximately 8 inches below at the base

of the wall stem to mitigate potential underseepage. A cleanout should be connected to the perforated pipe at the upstream end and no greater than 50-foot intervals by sweep fittings oriented in the flow direction. Once the pipe system is installed, place a minimum 12-inch wide prism of ¾- to 1 ½-inch clean crushed rock, separated from the adjacent soil by Mirafi 140N filter fabric, to within 18 inches of the finished ground surface. Cover the clean crushed rock with filter fabric prior to placement of a compacted site soil cap to the finished ground surface. The finished ground surface should have a positive slope to a catch basin and pipe system to carry water to an approved discharge location.

Surface Drainage

We believe a concrete V-ditch is not required because of the high probability it will not be maintained over time, and gopher burrowing quickly deems them ineffective. In our opinion, it will be necessary to rely on improvement and maintenance of controlled runoff on the unimproved gravel road upslope, and of canopy and ground cover to mitigate solar exposure and extreme soil temperature variations that results in deep desiccation cracking in this area.

Surface Soil Desiccation and Erosion

Following construction, barren soil surfaces should be covered with a suitable erosion mat (e.g., jute or better). For the long-term, we recommend you consult with a Landscape Contractor who can provide specific hillside landscape plans including low evergreen tree canopy and understory to effectively insulate the surface soils from extreme seasonal moisture variations that induce desiccation and erosion. To the extent practical, establish a gopher abatement program to mitigate the pervasive surface burrowing that induces surface runoff infiltration and concentrated underground seepage and erosion (i.e., piping).

MAINTENANCE

Periodic land maintenance will be required. It is essential all surface and subsurface drainage facilities be checked frequently, and cleaned and maintained as necessary.

SUPPLEMENTAL SERVICES

We recommend that we review the final grading and surface/subsurface drainage plans and retaining wall foundation and for conformance with the intent of our recommendations. During construction, we should observe the rough and finished grading operations, installation of all surface and subsurface drainage measures prior to backfill. We should observe pier drilling to verify design depths into bedrock, and final pier depths prior to steel placement.

Retaining walls should be observed for installation of backdrainage facilities prior to burial to ascertain that our recommendations are followed. Upon completion of the project, we should perform a site observation and report the results of our work in a final report. These services are outside the present scope and will be billed on a time and expense basis, in accordance with the fee schedule current at that time. These services will be performed only if we are provided with sufficient notice to perform the work. We do not accept responsibility for items that we are not notified to observe. We recommend that the Owner be responsible for notification, no less than 48 hours before the requested site visit.

INVESTIGATION LIMITATIONS

This report has been prepared in accordance with generally accepted geotechnical engineering principles and practices, and is in accordance with the standards and practices set by the geotechnical consultants in the area. This acknowledgment is in lieu of any warranties, either expressed or implied. We offer no guarantees.

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

This report is submitted with the understanding that it is the responsibility of the Client (Owner) to ensure that the applicable provisions of the recommendations contained herein are made known to all 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 such recommendations in the field.

If conditions different from those described in this report are encountered during construction, or if the project is revised, we should be notified immediately so that we may modify our recommendations, if warranted.

Given the geotechnical consulting industry will evolve, and site conditions can change over a short period of time, we should be consulted to update this report if the landslide repair is not performed within 12 months.

AERIAL IMAGERY

Google Earth interactive black and white and color imagery, 9/1948-11/2016

REFERENCES

Brabb, E.E., Graymer, R.W., Jones, D.L., 1998, Geology of the onshore part of San Mateo County, California: A digital database, U.S. Geological Survey Open-File Report 98-137, map scale 1:62,500.

Earth Investigations Consultants, Inc., 2013, Geotechnical investigation, proposed single family residence, 634 Palomar Park, Redwood City, California: Geotechnical consultant's October 17 report to Mr. Robert Kirk, Job 2537.01.00, 12 pgs with illustrations.

The following plates and appendix are attached and complete this report:

Plates

- Plate 1 – Vicinity Map
- Plate 2 – Site Plan, Cross Section A-A' and Photos 1 & 2
- Plate 3 – Geologic Map
- Plate 4 – Mitigation Plan and Section
- Plate 5 – Typical Fill Slope Details

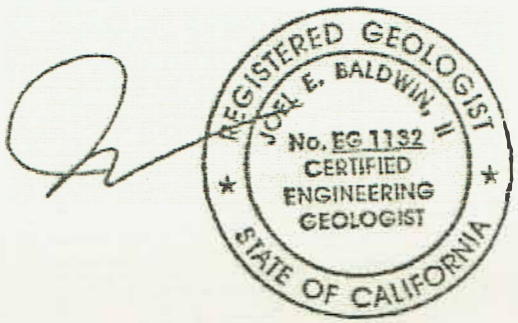
Appendix A – Boring Logs and Laboratory Test Results

- Plate A1 – Logs of Borings 1 and 2
- Plate A2 – Log of Boring 3
- Plate A3 – Key to Borings
- Plate A4 – Rock Hardness Criteria
- Plate A5 – Plasticity Chart

We trust this report provides you with the information you require at this time. If you have any questions, please call.

Very truly yours,

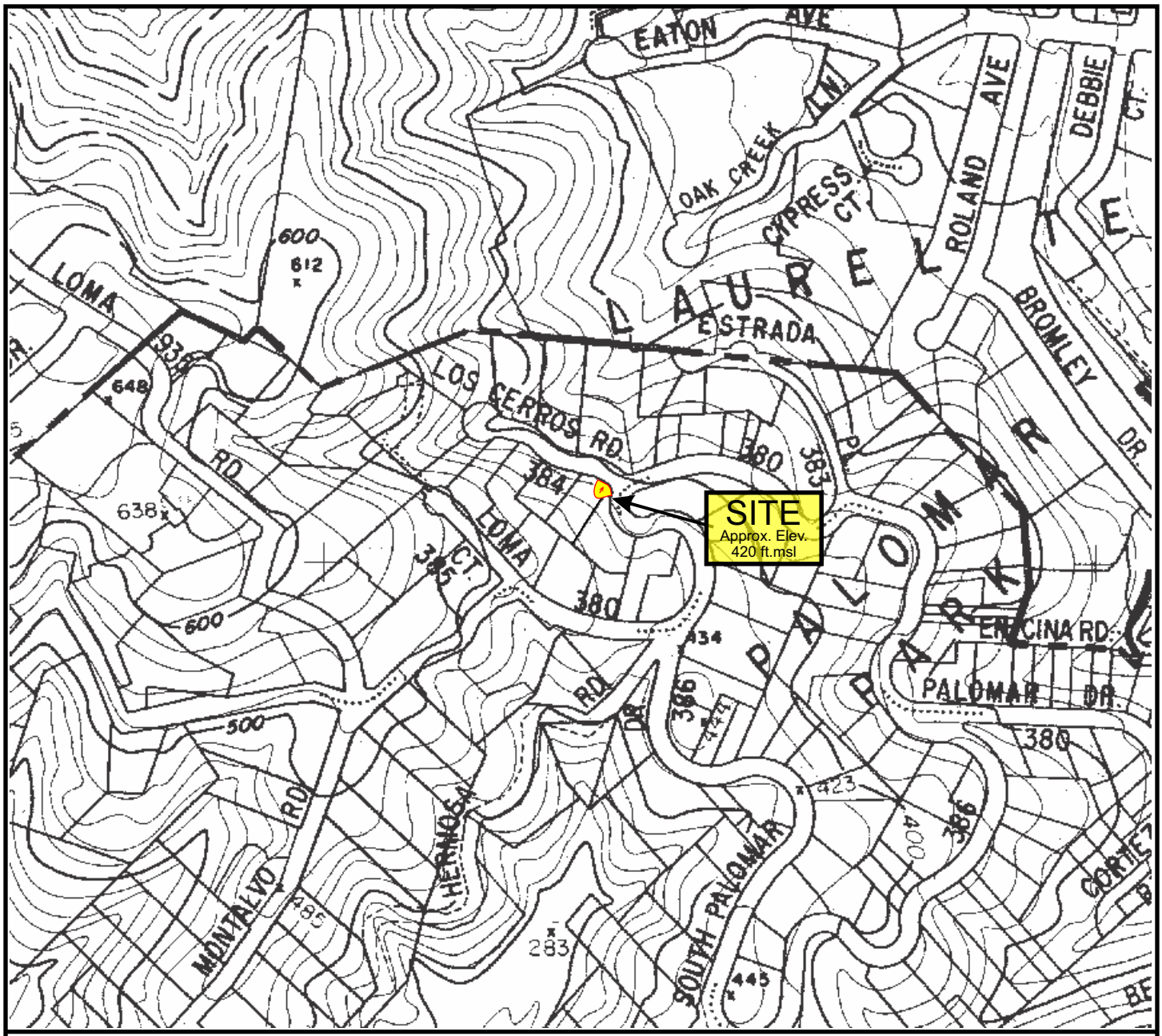
Earth Investigations Consultants, Inc.



Joel E. Baldwin, II
Engineering Geologist 1132 (Renewal date 2/28/19)

Robert D. Mahony
Geotechnical Engineer 554 (Renewal Date 6/30/17)

JEB:RDM:jb:gi
Distribution: 3 bound copies and e-file to addressee



N

0 400 ft.

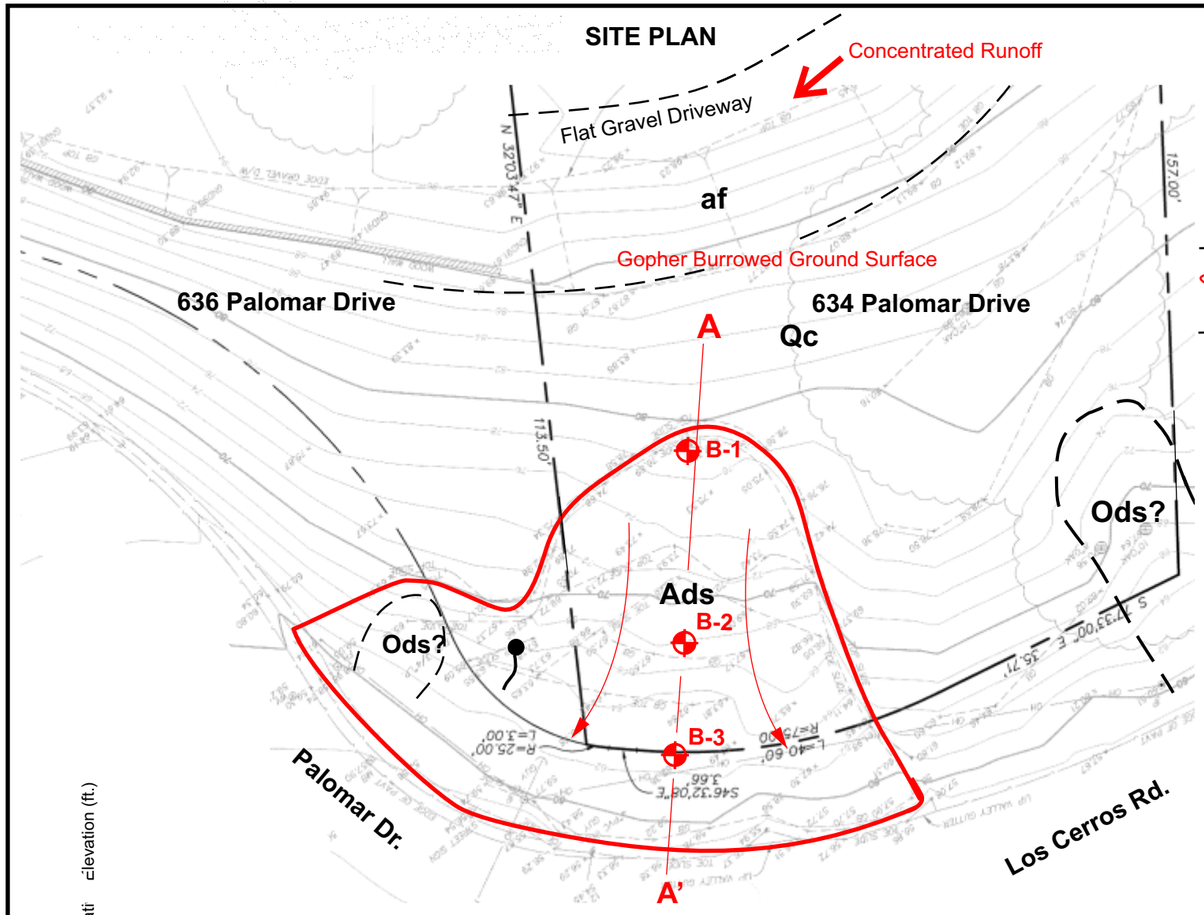
Scale

Contour interval = 20'

San Mateo County Topographic Map 11G (1/1/96)

Earth Investigations Consultants, Inc.	**Job No.:** 2572.01.01 **Approved By:** JEB **Date:** 04/11/17	**VICINITY MAP** 634 Palomar Drive Redwood City, California	**Plate** 1

SITE PLAN



EXPLANATION

MAP & SECTION UNITS & SYMBOLS

Ads	Active Debris Slide
Ods	Older Debris Slide
Qc	Colluvium
KJfs	Franciscan Sandstone
?	Inferred Geologic Contact
	Approximate limits of Active Debris Slide
	Approximate limits of Older Debris Slide
	Seepage
B-1	Approximate location of Boring 1
A A'	Line of Cross Section A-A'
B-1 TD=6'	Approximate location and total depth (TD) drilled at Boring 1 in Cross Section A-A'

UAF IMAGE ANNOTATIONS

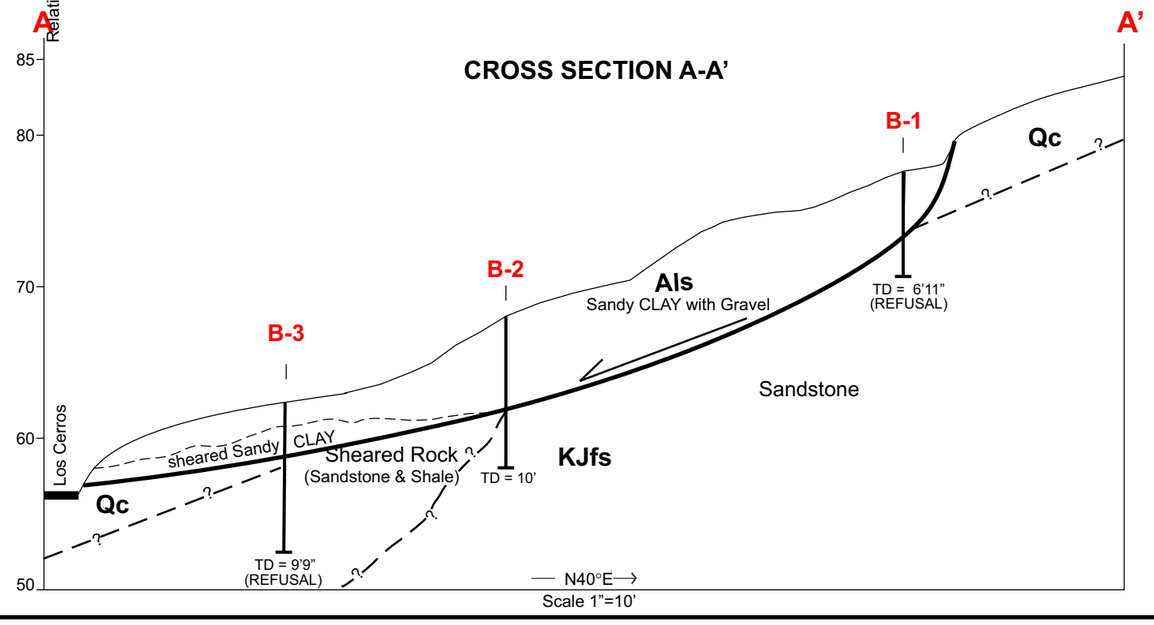
	Appox limit of Ads
	Unimproved driveway direction of runoff
1	Crown
2	Toe
3	Desiccation crack controlled scarps
4	Debris flow
5	Seepage

N

0 20 ft.
Map Scale

Map from: Giuliani & Kull, Inc.
Sheet 1 Dated 03.24.17

CROSS SECTION A-A'



PHOTOS 1 & 2

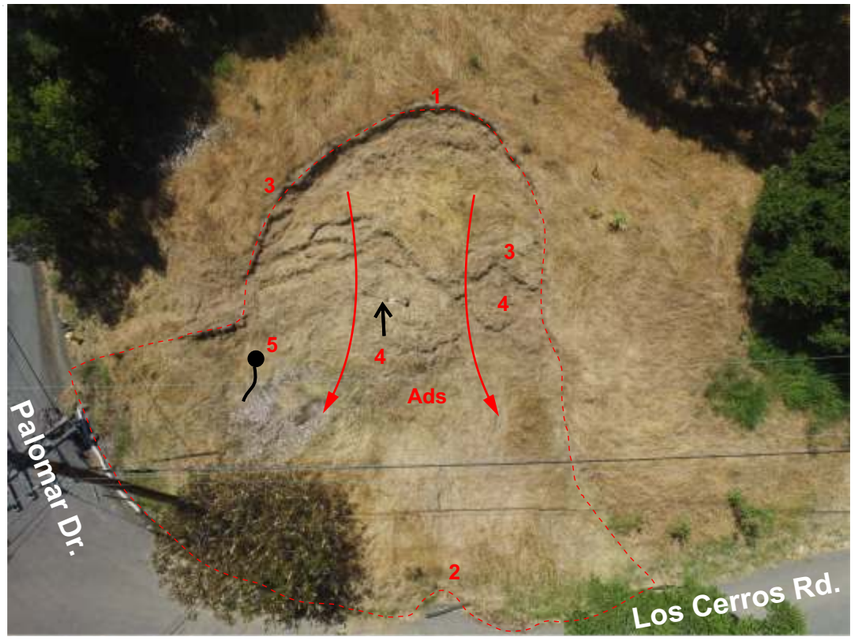
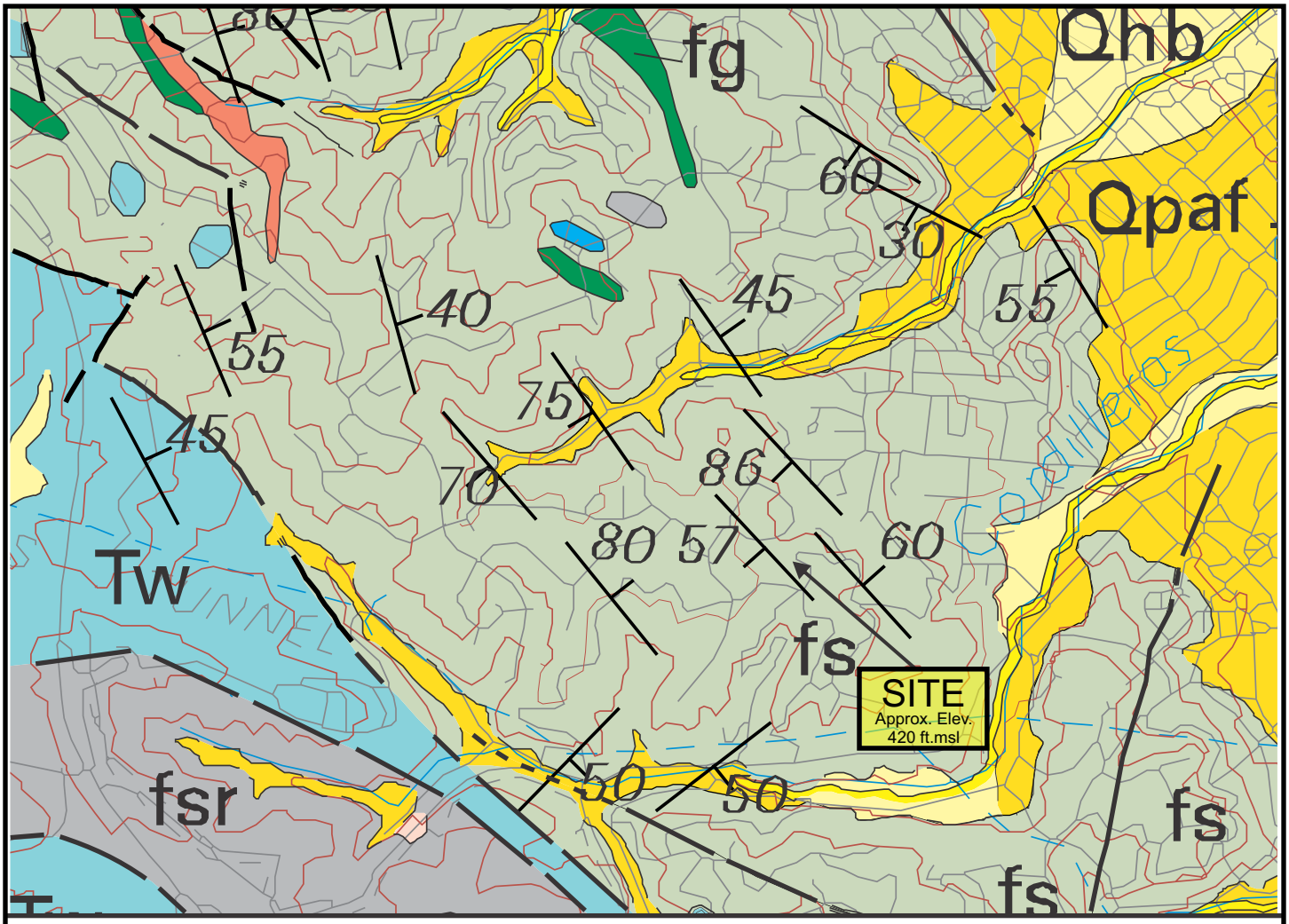


Photo 1: Aerial view of Active Debris Slide. Arrow points to 5 ½' long wqeed-wacker for scale.

Photo 1. Southwesterly oblique view of property uphill of affected slope. Homes at top on Loma Rd.

Earth Investigations Consultants, Inc.	**Job No.:** 2572.01.01 **Approved By:** JEB **Date:** 06/01/17	**SITE PLAN, CROSS SECTION A-A' and PHOTOS 1 & 2** 634 Palomar Drive Redwood City, California	**Plate** 2



EXPLANATION

- Qhb — Basin deposits (Holocene)
- Qpaf — Alluvial fan and fluvial deposits (Pleistocene)
- Tw — Whiskey Hill Formation (middle and lower Eocene)

Franciscan Complex

- fs — Sandstone
- fg — Greenstone
- fsr — Sheared rock (melange)

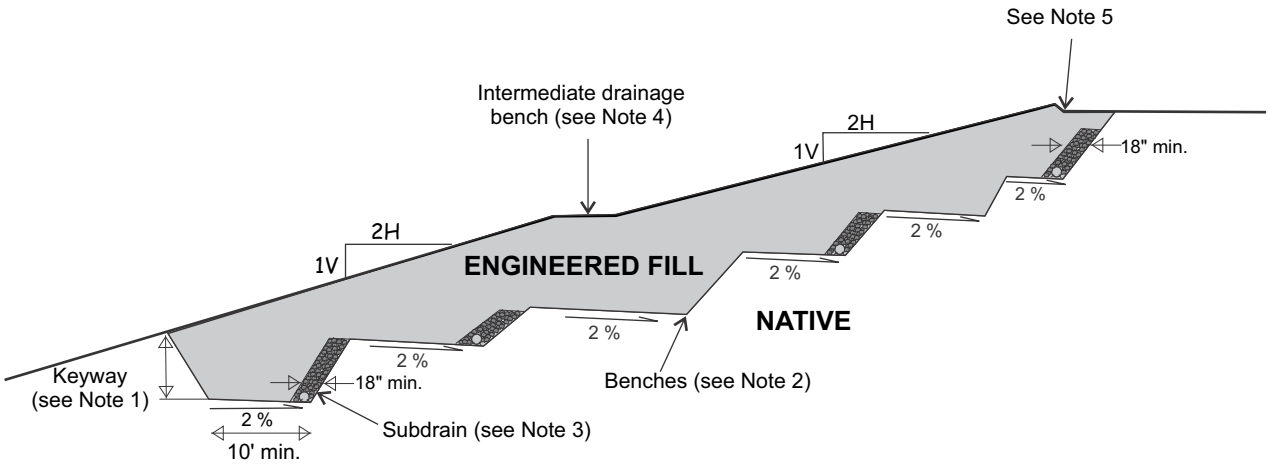
- Contact—Depositional or intrusive contact, dashed where approximately located, dotted where concealed
- Fault—Dashed where approximately located, small dashes where inferred, dotted where concealed, queried where location is uncertain.
- 35 — Strike and dip of bedding

N

0 ——— 2000 ft.
Scale

Brabb & others (1998)

Earth Investigations Consultants, Inc.	**Job No.:** 2572.01.01 **Approved By:** JEB **Date:** 04/11/17	**GEOLOGIC MAP** 634 Palomar Drive Redwood City, California	**Plate** 3



NOT TO SCALE

NOTES:

1. Key engineered fill at least 5 feet into competent native earth material, as determined by the soil engineer. Keyway should have a minimum width of 10 feet (not applicable when toe supported by retaining wall). Native soil exposed in the key should be scarified to a minimum depth of 8 inches, moisture conditioned to near optimum and compacted to at least 90 percent relative compaction.

2. Where natural grade is sleeper than 7H:1V, bench into competent, native earth material, as determined by the soil engineer.

3. Subdrains should be placed along the back edge of the keyway and every 15 to 20 feet vertically along the excavation back cut, as determined by the soil engineer. Subdrain should be min. 4“ diameter, perforated PVC drainpipe (Schedule 40 or equivalent), slope 2% min. with holes down. Install clean-out at every 50 feet or bends greater than 45 degrees. Connect to solid Schedule 40 PVC pipe and discharge into city storm drain system or onto approved erosion protected surface.

4. Minimum 5 feet wide intermediate drainage bench with concrete-lined V-ditch should be spaced 25 vertical feet on slopes higher than 30 feet.

5. Engineered fill berm or reinforced concrete V-ditch to control runoff at top of fill slope.

Earth Investigations Consultants, Inc.	**Job No.:** 2572.01.01 **Approved By:** JEB **Date:** 04/11/17	**TYPICAL FILL SLOPE DETAILS** 634 Palomar Drive Redwood City, California	**Plate** 5

APPENDIX A

Logs of Borings and Laboratory Test Results

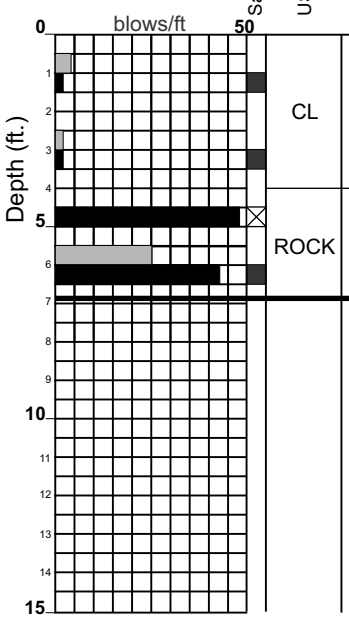
Plate A1 – Logs of Borings 1 & 2
Plate A2 – Log of Boring 3
Plate A3 – Key to Borings
Plate A4 – Rock Hardness Chart
Plate A5 – Plasticity Chart

BORING 1

Equipment Portable Equipment

Elevation ~76 ft.* **Date** 05/17/17

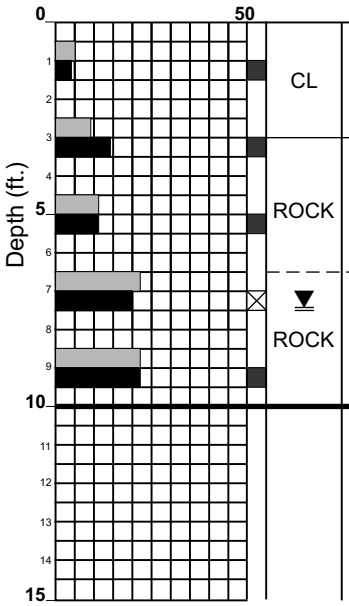
-200 Sieve (%)	Dry Density (pcf)	Moisture Content %	Blows/Foot (SPT)	USCS	Description
	95.4	16.8	5	CL	Dark yellow brown Sandy CLAY with Gravel (COLLUVIUM), moist, firm (ACTIVE DEBRIS SLIDE, Ads)
73	90.9	25.9	5		
			47/6"	ROCK	Yellow brown & dark brown SANDSTONE, very weathered, closely fractured, moderately hard (BEDROCK, KJfs)
	125.5	5.9	67		
					Refusal @ 6'11"



BORING 2

Elevation ~67 ft.* **Date** 05/17/17

-200 Sieve (%)	Dry Density (pcf)	Moisture Content %	Blows/Foot (SPT)	USCS	Description
	96.4	13.4	6	CL	Dark yellow brown Sandy CLAY with Gravel (COLLUVIUM), damp, firm (ACTIVE DEBRIS SLIDE, Ads)
	117.1	14.2	26	ROCK	Dark yellow brown sheared Sandstone and Shale, soft, saturated slight seepage @ 4' (ACTIVE DEBRIS SLIDE, Ads)
	121.9	13.5	27		
			43	ROCK	Dark yellow brown shared, closely fractured, moderately hard (BEDROCK, KJfs)
	122.5	9.5	44		
					Terminated @ 10'



*approximate elevation from Giuliani & Kull, Inc. Sheet 1 dated 03/24/17

▼ water level @ approximately 7½' post drilling

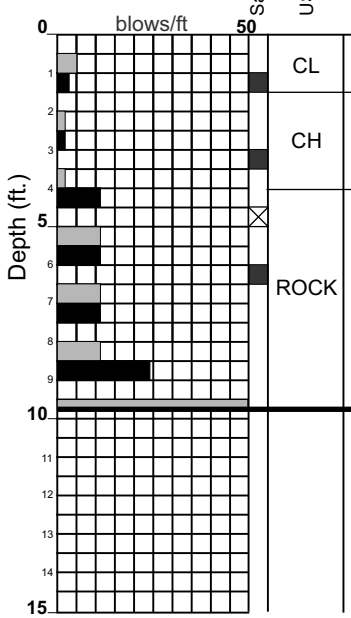
Earth Investigations Consultants, Inc.	**Job No.:** 2572.01.01 **Approved By:** JEB **Date:** 04/11/17	**LOGS OF BORINGS 1 & 2** 634 Palomar Drive Redwood City, California	**Plate** A1

BORING 3

Equipment Portable Equipment

Elevation ~63 ft.* **Date** 06/07/17

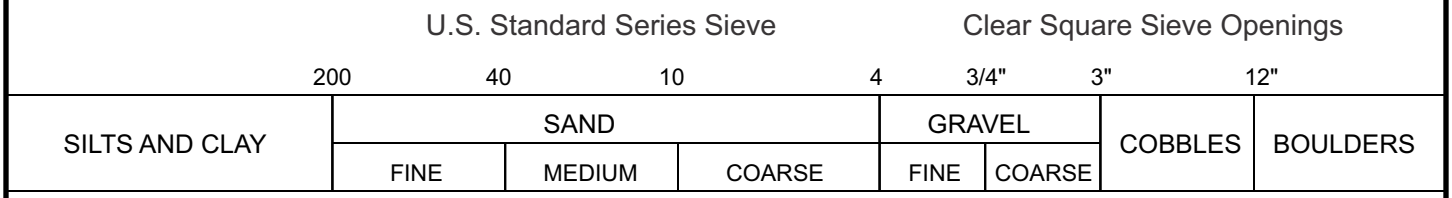
-200 Sieve (%)	Dry Density (pcf)	Moisture Content %	Blows/Foot (SPT)	Sample	USCS	Description
	90.0	15.4	8		CL	Yellow brown Sandy CLAY with Gravel, moist, firm (ACTIVE DEBRIS SLIDE, Ads)
	105.0	17.1	3		CH	Dark yellow brown Sandy CLAY, damp, firm color grades to yellow brown @ 2'; sheared; very plastic CLAY (basal rupture surface) @ 3½'
84						
			13			
	107.8	9.6	24		ROCK	Dark yellow brown SHEARED ROCK, very weathered, closely fractured, soft (BEDROCK, KJfs)
			24			
			36			
	125.8	11.0	50/3"			Refusal @ 9'9"



*approximate elevation from Giuliani & Kull, Inc. Sheet 1 dated 03/24/17

Earth Investigations Consultants, Inc.	**Job No.:** 2572.01.01 **Approved By:** JEB **Date:** 04/11/17	**LOG OF BORING 3** 634 Palomar Drive Redwood City, California	**Plate** A2

			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.



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 split spoon, SPT sampler (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.

Grab sample

Water encountered during drilling

Water level post drilling

59 Total number of SPT blow counts for sampling interval. Bar graph represents individual 6-inch intervals.

Unified Soil Classification System (ASTM D-2487)

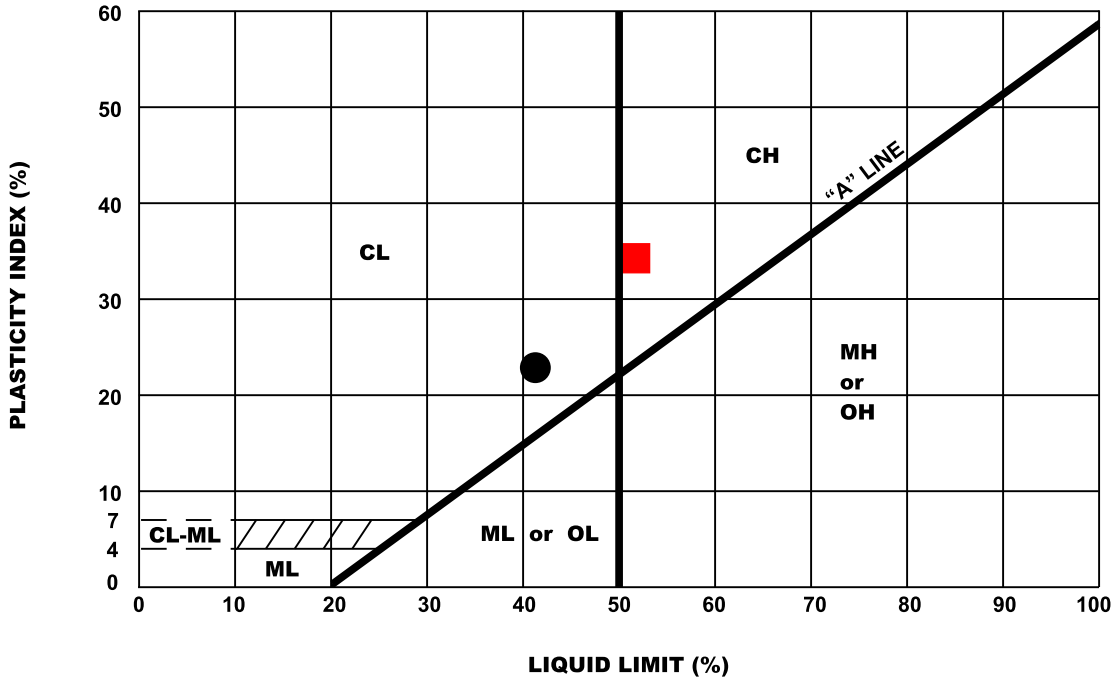
Earth Investigations Consultants, Inc.	**Job No.:** 2572.01.01 **Approved By:** JEB **Date:** 04/11/17	**KEY TO BORINGS** 634 Palomar Drive Redwood City, California	**Plate** A3

ROCK HARDNESS CRITERIA

Very Hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimen requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately Hard	Can be scratched with knife or pick. Gouges or grooves to 1/4 inch deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 inch deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1 inch maximum size by hand blows of the point of geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of pick point. Small thin pieces can be broken by finger pressure.
Very Soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1 inch or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Subsurface Manual for Design and Construction of Foundations of Buildings, 1976
Published by American Society of Civil Engineers.

Earth Investigations Consultants, Inc.	**Job No.:** 2572.01.01 **Approved By:** JEB **Date:** 04/11/17	**ROCK HARDNESS CHART** 634 Palomar Drive Redwood City, California	**Plate** A4



KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	NATURAL WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING NO. 200 SIEVE (%)	LIQUIDITY INDEX	USCS
●	B-1	3 ½'	26	41	23	73	0.30	CL
■	B-3	3 ½'	32	51	34	84	0.41	CH

Earth Investigations Consultants, Inc.	**Job No.:** 2572.01.01 **Approved By:** JEB **Date:** 04/11/17	**PLASTICITY CHART** 634 Palomar Drive Redwood City, California	**Plate** A6