Project No.
9223.000.000

April 22, 2011

Mr. Victor Alaniz
Nolte Associates, Inc.
2495 Natomas Park Drive, Fourth Floor
Sacramento, CA 95833-2935

Subject: City of Brentwood Pipeline – O' Hara Avenue
Brentwood, California

GEOTECHNICAL EXPLORATION FOR PIPELINE ALIGNMENT

Dear Mr. Alaniz:

At your request, we conducted a geotechnical exploration along the alignment of a proposed 12 inch non-potable water line that will connect to the existing water lines at the intersection of Grant Street and O'Hara Avenue, extend west to the intersection of Grant Street and Shady Willow Lane, and continue south to terminate at the intersection of Shady Willow Lane and Empire Avenue.

The accompanying report contains our exploration data, conclusions, and recommendations for development of the proposed water line. It is our opinion that the currently proposed water line is feasible from a geotechnical standpoint provided the recommendations included in this report are incorporated into the project design and implemented during construction.

The purpose of this study was to gather information regarding subsurface conditions along the proposed water pipe alignment and to prepare recommendations as deemed appropriate to reduce risk of geologic hazards impacting the waterline. Various geotechnical studies have been conducted on neighboring developments to the proposed water line alignment. Studies include explorations performed by ENGEO in 2000, 2002, and 2004 and Kleinfelder in 2001 and 2003. Select boring locations and corresponding boring logs from the previous investigations are included in Figure 2 and Appendix C, respectively.

Our scope for this geotechnical exploration included reviewing pertinent geologic maps and previous geotechnical reports; performing six soil borings between 3 and 27 feet deep; laboratory testing of collected soil samples; engineering analysis; and preparation of this report.

FIELD EXPLORATION

Our field exploration was performed on April 6, 2011. The field exploration consisted of drilling six borings to a maximum depth of approximately 26½ feet at the approximate locations shown on Figure 2. The exploration locations were approximately located by pacing from existing features and the use of a topographic map and aerial photographs. Boring logs are presented in Appendix A.

Borings 1-B2 and 1-B3 were drilled with a truck-mounted Soil Test Ranger drill rig equipped with 4-inch-diameter solid flight augers and a 140-pound hammer with a 30-inch drop, employing a rope and cathead hammer system. Borings 1-B1, 1-B4 through 1-B6 were drilled using a hand auger. An ENGEO engineer logged the borings in the field and collected soil samples using either a 3-inch O.D. California-type split-spoon sampler fitted with 6-inch-long brass liners or obtaining bag samples from cuttings. The penetration of the samplers into the native materials was field-recorded as the number of blows needed to drive the sampler 18 inches in 6-inch increments. Blow count results on the boring logs were recorded as the number of blows required for the last 1 foot of penetration, or the distance indicated if driving refusal was encountered.

Following the field exploration, we reexamined the samples in our laboratory to confirm field classifications. Select samples recovered from the borings were tested for moisture content.

FINDINGS

SITE GEOLOGY

The site is located in the Coast Ranges geomorphic province on the eastern side of the Diablo Range. Brabb, Sonneman and Switzer (1971), Atwater (1982), and Nilsen (1975) have mapped the geology in this area during regional studies. Nilsen has mapped Quaternary age alluvial fan-terrace deposits (Qft) overlying the majority of the site. These deposits are generally described as unconsolidated sand, silt, clay, and minor gravel. Faults in the area were mapped by Atwater (1982) of the U.S. Geological Survey, and Jennings (1977) of the California Geological Survey (CGS).

FAULTING AND SEISMICITY

No known active faults are mapped across the proposed pipeline alignment. The nearest State of California zoned active[1] strike-slip fault zones are the Greenville and Concord faults, located approximately 10 miles southwest and 13 miles west, respectively. Locations of regional faults with respect to the site are presented on Figure 3. Because of the presence of active faults in the San Francisco region, the Brentwood area is considered seismically active.

A segment of the Great Valley Fault has been identified within 5 miles of the site (Blake, 2000). The Great Valley Fault is a blind thrust fault with no known surface expression; the postulated fault location has been based on regional seismic activity and isolated subsurface information. Portions of the Great Valley fault are considered seismically active thrust faults; however, since the Great Valley fault segments are not known to extend to the ground surface, the State of California has not defined Earthquake Fault Hazard Zones around the postulated traces. The Great Valley fault is considered capable of causing high ground shaking at the site, but the recurrence interval is believed longer than for more distant, strike-slip faults. Recent studies suggest that this boundary fault may have been the cause of the Vacaville-Winters earthquake sequence of April 1892 (Eaton, 1986; Wong and Biggar, 1989; Moores and others, 1991). Numerous small earthquakes occur every year in the region, and large (>M7) earthquakes have been recorded and can be expected to occur in the future.

[1] An active fault is defined by the California Geologic Survey as one that has had surface displacement within Holocene time (about the last 11,000 years) (Hart, 1994). The State of California has prepared maps designating zones for special studies that contain these active earthquake faults.

SUBSURFACE CONDITIONS

The soil encountered in our exploration locations generally consisted primarily of silty clays with variable layers of sandy and clayey silts and silty and clayey sands to the maximum depth explored of 26½ feet. Refer to the exploratory boring logs presented in Appendix A and Appendix C for a detailed description of the soil conditions at each location explored. Figure 4 presents soil encountered in individual borings along the proposed pipeline alignment.

GROUNDWATER CONDITIONS

Groundwater was encountered in two of our borings during drilling at depths of 21 feet and 24 feet below the existing ground surface for Borings 1-B2 and 1-B3, respectively. Fluctuations in groundwater levels are expected to occur seasonally in response to changes in precipitation, irrigation, and other factors not evident at the time of our exploration.

CONCLUSIONS AND RECOMMENDATIONS

It is our opinion that the currently proposed waterline alignment is feasible from a geotechnical standpoint provided the recommendations included in this report are incorporated into the project design and implemented during construction. The primary geotechnical concerns that could affect design and construction are rock excavatability and stand up time of the on-site soils materials during trenching. Our conclusions and recommendations are summarized below.

EXCAVATABILITY

Based on our experience in the area and our site exploration, it appears that a backhoe or similar sized excavation equipment would likely be able to excavate much of the proposed waterline trench. We provide the above excavatability information for general planning purposes only. This information is not intended for bidding purposes.

TRENCHING

The Contractor will be solely responsible for the design and construction of any temporary shoring, if needed, and should take into consideration the protection of adjacent improvements to prevent damage to the improvements.

Excavations greater than 5 feet in depth could be temporarily shored using trench shields, a soldier beam, and lagging or sheet pile wall shoring schemes appropriately designed by a qualified registered engineer. Depending on the depth of shoring, magnitude of lateral loads, and proximity of existing site improvements, braced or unbraced shoring may be used. The contractor should incorporate all appropriate requirements of OSHA into the design of any temporary shoring system. Proper tools and equipment should be used in breaking pavement so that it will be cut accurately to the correct lines. Trench dimensions should conform with the City of Brentwood Standards and Specifications. Where the alignment is in a paved road, saw-cutting machine should include a vacuum device such that all residue from the saw-cutting process is contained and properly disposed.

In general, all trenches and construction slopes should be backfilled as soon as possible. Trenching conducted during wet weather with significant rainfall will be difficult and the trench will tend to collapse. Light rain may not delay construction and would tend to improve soil stand-up time in most cases; however, this should not be relied upon and wet weather construction is likely to be problematic. Additional recommendations for wet weather construction can be provided at the time of construction, if required.

Final design criteria will be dependent on the shoring system selected by the Contractor. We recommend that the Contractor be responsible for final shoring design and for providing adequate excavation support. Geotechnical recommendations and design parameters should be developed by the Contractor's Geotechnical Engineer after the shoring system has been selected.

BORE AND JACK/MICRO-TUNNELING

If bore and jack/micro-tunneling methods are to be used, the design and construction should be performed by a qualified Contractor and designer experienced in such installation methods. Thrust blocks for the jacking operation can be designed using an equivalent fluid weight of 200 pounds per cubic foot (pcf) with a maximum allowable pressure of 2,500 psf. In addition, a maximum allowable friction coefficient of 0.30, acting between the concrete thrust block and the bottom of the jacking pit, may be used to resist lateral loads.

TRENCH BACKFILL

Trench should be backfilled in accordance with the City of Brentwood Standards and Specifications.

PIPELINE DESIGN

The pipe should be designed to resist loads imposed on overlying soil cover and from vehicle or construction traffic. Soil loads may be calculated using a total unit weight of 125 pounds per cubic foot. Where the pipeline changes direction, thrust will tend to move the pipe. These movements can be resisted by friction between the pipe and the surrounding fill, restrained joints, and/or trust blocks.

According to the City of Brentwood Standard Detail, concrete thrust blocks should be used along the alignment. The lateral capacity of thrust blocks may be designed using a uniform lateral bearing pressure of 2,500 pounds per square foot.

CORROSION

Five representative samples of the near-surface soils between 3 feet and 6 feet below the existing grade were collected during our field exploration and submitted to Sunland Analytical for chemical testing. The test results are included in Appendix B. The purpose of this testing was to determine the general corrosive conditions along the pipeline alignment. A licensed corrosion engineer should be consulted regarding all corrosivity design for the project.

Sulfate

The samples were tested in accordance with Caltrans Test #417 for sulfate and contained between 20.2 and 394.8 ppm water-soluble sulfate (SO_4) concentration levels.

The 2010 CBC references the 2008 American Concrete Institute Manual, ACI 318 (Chapter 4, Sections 4.2 and 4.3) for concrete requirements. ACI Tables 4.2.1 and 4.3.1 provide the following sulfate exposure categories and classes and concrete requirements in contact with soil based upon the exposure risk.

TABLE 1
Sulfate Exposure Categories and Classes

Category S Sulfate	Exposure Class	Water- Soluble Sulfate in Soil	Dissolved Sulfate in Water
		% by Weight	mg/kg (ppm)
Not Applicable	S0	$SO_4 < 0.10$	$SO_4 < 150$
Moderate	S1	$0.10 \leq SO_4 < 0.20$	$150 \leq SO_4 \leq 1{,}500$ seawater
Severe	S2	$0.20 \leq SO_4 \leq 2.00$	$1{,}500 \leq SO_4 \leq 10{,}000$
Very Severe	S3	$SO_4 > 2.00$	$SO_4 > 10{,}000$

TABLE 2
Requirements for Concrete by Exposure Class

Exposure Class	Max w/cm	Min f'c (psi)	Cement Type			Calcium Chloride Admixture
			ASTM C150	ASTM C595	ASTM C1157	
S0	N/A	2,500	No Type restriction	No Type restriction	No Type restriction	No restriction
S1	0.5	4,000	II†‡	IP(MS), IS(<70) (MS)	MS	No restriction
S2	0.45	4,500	V‡	IP(HS) IS(<70) (HS)	HS	Not permitted
S3	0.45	4,500	V + pozzolan or slag§	IP(HS) + pozzolan or slag or IS(<70) (HS) + pozzolan or slag§	HS + pozzolan or slag§	Not permitted

Notes: † For seawater exposure, other types of portland cements with tricalcium aluminate (C_3A) contents up to 10 percent are permitted if the w/cm does not exceed 0.40.

‡ Other available types of cement such as Type III or Type I are permitted in Exposure Classes S1 or S2 if the C_3A contents are less than 8 or 5 percent, respectively.

§ The amount of the specific source of the pozzolan or slag to be used shall not be less than the amount that has been determined by service record to improve sulfate resistance when used in concrete containing Type V cement. Alternatively, the amount of the specific source of the pozzolan or slag to be used shall not be less than the amount tested in accordance with ASTM C1012 and meeting the criteria in ACI 4.5.1.

In accordance with the criteria presented in 2008 ACI Building Code, the test results are classified in the "Not Applicable" to "Moderate" sulfate exposure class. Cement type, maximum water-cement ratio, and minimum strength are specified by the ACI for the moderate range as Type II, 0.5, and 4,000 psi respectively.

Chloride

The samples were tested in accordance with Caltrans Test #422 for chloride and contained chloride concentrations between 14.4 and 179.6 ppm. The 2003 Caltrans Corrosion Guidelines do not consider chloride concentrations less than 500 ppm to be corrosive.

Soil Resistivity

The samples were tested in accordance with Caltrans Test #643 for minimum resistivity with minimum resistivities reported between 430 and 1,690 ohm-cm. According to the Caltrans Corrosion Guidelines, a minimum resistivity value for soil less than 1,000 ohm-cm indicates a potential for corrosion.

pH

The samples were tested in accordance with Caltrans Test #643 for pH with pH values reported between 7.31 and 7.95. These values are slightly basic based on a neutral pH of 7. The Caltrans Corrosion Guidelines does not consider a pH of greater than 5.5 to be corrosive.

LIMITATIONS

This report presents geotechnical recommendations for construction of the non-potable water line within the City of Brentwood right-of-way. 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.

We strive to perform our professional services in accordance with generally accepted geotechnical engineering principles and practices currently employed in the area; no warranty is expressed or implied.

We developed this report with limited subsurface exploration data. We assumed that our subsurface exploration data is representative of soil/rock and groundwater conditions across the site. Considering possible underground variability of soil, rock, and groundwater, additional costs may be required to complete the project. We recommend that the owner establish a contingency fund to cover such costs. If unexpected conditions are encountered, notify ENGEO immediately to review these conditions so that we can provide additional and/or modified recommendations, as necessary.

The location and elevations of our borings are approximate and were estimated by pacing from features shown on Figure 2.

Our work did not include design of excavation shoring, design of corrosion protection, soil volume change factors, flood potential, or a geohazard exploration.

This geotechnical exploration did not include work to determine the existence of possible hazardous materials. If any hazardous materials are encountered during construction, the proper regulatory officials should be notified immediately.

If you have any questions regarding the contents of this report, please contact us.

Sincerely,

ENGEO Incorporated

REGISTERED PROFESSIONAL ENGINEER
STEVE HARRIS
No. 2804
Exp. 6/30/2012
GEOTECHNICAL
STATE OF CALIFORNIA

Randy Hildebrant Steve Harris, GE

Attachments: Figures 1 through 4
Appendix A – Bore Logs
Appendix B – Laboratory Tests
Appendix C – Previous Explorations Bore Logs

SELECTED REFERENCES

Atwater, B.F., 1982, Geologic Maps of the Sacramento – San Joaquin Delta, California, U.S. Geological Survey, Miscellaneous Field Studies Map MF 1401.

Blake, T. F., 2000, EQFAULT, A Computer Program for the Deterministic Prediction of Peak Horizontal Acceleration from Digitized California Faults.

Brabb, E.E., Sonneman, H.S., and Switzer, J.R., 1971, Preliminary Geologic Map of the Mount Diablo - Byron Area, Contra Costa County, Alameda, and San Joaquin Counties,

California, U.S. Geological Survey Open File Map 71-53.

California Department of Transportation (Caltrans); Corrosion Guidelines, Version 1.0, September 2003

ENGEO; Geotechnical Exploration, Maggiore Properties, Brentwood, California; dated December 6, 2000; Project No. 5122.5.001.01

ENGEO; Geotechnical Exploration, Montelena II, Subdivision 8663, Brentwood, California; dated December 27, 2002; Project No. 5122.4.002.01

ENGEO; Geotechnical Exploration, 135-ACRE S&S Farms, Brentwood, California; dated April 30, 2004; Project No. 5535.4.008.01

Jennings, 1975, Fault Map of California, CDMG Geological Data Map 1.

Kleinfelder; Geotechnical Investigation Report, Proposed Apricot Way, Residential Subdivision Apricot Way, Brentwood, California; dated December 20, 2001; File No. 43-1429-01.GEO

Kleinfelder; Geotechnical Investigation Report, Subdivision 8601 (Nunn Property), North Side of Apricot Way, Brentwood, California; dated July 11, 2003; File No. 29085.GEO

LIST OF FIGURES

Figure 1 - Vicinity Map

Figure 2 - Site Plan

Figure 3 - Regional Faulting and Seismicity

Figure 4 - Subsurface Exploration Schematic

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BASE MAP SOURCE: MS STREETS AND TRIPS

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VICINITY MAP

CITY OF BRENTWOOD PIPELINE

BRENTWOOD, CALIFORNIA

PROJECT NO.:	9223.000.000
SCALE:	AS SHOWN
DRAWN BY:	DLB
CHECKED BY:	SH
FIGURE NO.	1

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ORIGINAL FIGURE PRINTED IN COLOR

EXPLANATION

- 1-B6 — APPROXIMATE LOCATION OF BORING (ENGEO, 2011)
- B-2 — APPROXIMATE LOCATION OF BORING (ENGEO, 2004)
- B-4 — APPROXIMATE LOCATION OF BORING (KLEINFELDER, 2003)
- B-3 — APPROXIMATE LOCATION OF BORING (ENGEO, 2002)
- B-5 — APPROXIMATE LOCATION OF BORING (KLEINFELDER, 2001)
- B-3 — APPROXIMATE LOCATION OF BORING (ENGEO, 2000)
- APPROXIMATE LOCATION OF PROPOSED PIPELINE ALIGNMENT

BASE MAP SOURCE: UNKNOWN

ENGEO Expect Excellence

SITE PLAN
CITY OF BRENTWOOD PIPELINE
BRENTWOOD, CALIFORNIA

PROJECT NO.: 9223.000.000	FIGURE NO. 2
SCALE: AS SHOWN	
DRAWN BY: DLB	CHECKED BY: SH

ORIGINAL FIGURE PRINTED IN COLOR

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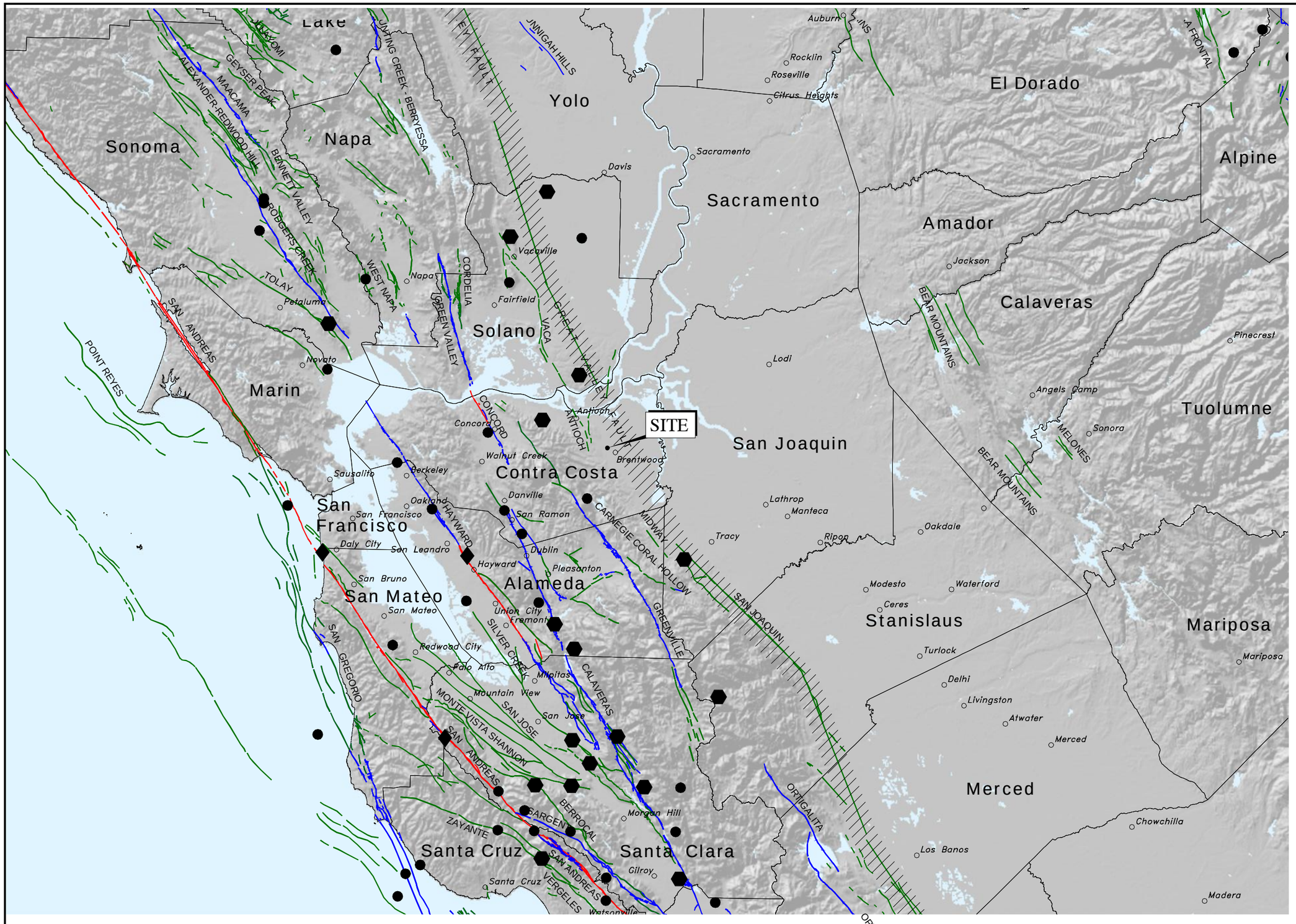

EXPLANATION

- MAGNITUDE 7+
- MAGNITUDE 6-7
- MAGNITUDE 5-6
- HISTORIC FAULT
- HOLOCENE FAULT
- QUATERNARY FAULT
- HISTORIC BLIND THRUST FAULT ZONE

BASE MAP SOURCE:
U.S.G.S. 1-ARC SECOND S.R.T.M. DATABASE
U.S.G.S. QUATERNARY FAULT DATABASE, MARCH, 2006
U.S.G.S. HISTORIC EARTHQUAKE DATABASE (1800-2000)

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REGIONAL FAULTING AND SEISMICITY
CITY OF BRENTWOOD PIPELINE
BRENTWOOD, CALIFORNIA

PROJECT NO.: 9223.000.000	FIGURE NO 3
SCALE: AS SHOWN	
DRAWN BY: DLB	CHECKED BY: SH

ORIGINAL FIGURE PRINTED IN COLOR

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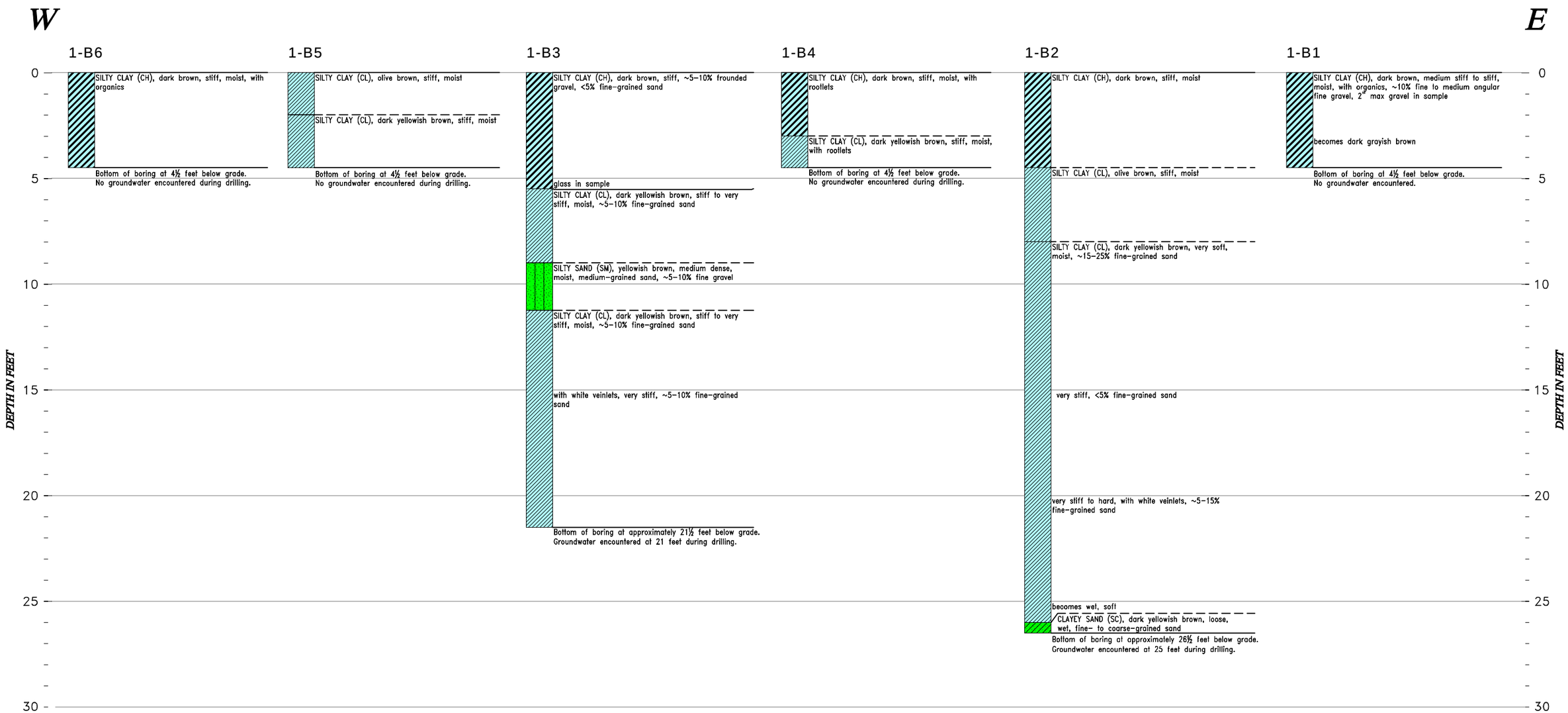

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SUBSURFACE EXPLORATION SCHEMATIC
CITY OF BRENTWOOD PIPELINE
BRENTWOOD, CALIFORNIA

PROJECT NO.: 9223.000.000		FIGURE NO.
SCALE: NO SCALE		4
DRAWN BY: DLB	CHECKED BY: SH	

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APPENDIX A

Boring Logs

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.

GRAIN SIZES

U.S. STANDARD SERIES SIEVE SIZE				CLEAR SQUARE SIEVE OPENINGS			
200	40	10	4	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
- 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

ENGEO INCORPORATED

Geotechnical Exploration
City of Brentwood Pipeline
Brentwood, CA
9223.000.000

DATE DRILLED: 4/6/2011
HOLE DEPTH: 4.5 ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 89 ft.

LOGGED / REVIEWED BY: R. Hildebrant / SH
DRILLING CONTRACTOR: ENGEO Incorporated
DRILLING METHOD: Hand Auger
HAMMER TYPE: N/A

Depth in Feet	Depth in Meters	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)	Unconfined Strength (tsf) *field approx
	1		SILTY CLAY (CH), dark brown, medium stiff to stiff, moist, with organics, ~10% fine to medium angular fine gravel, 2" max gravel in sample becomes dark grayish brown										
			Bottom of boring at 4½ feet below grade. No groundwater encountered.										

LOG OF BORING 1-B2

ENGEO INCORPORATED

Geotechnical Exploration
City of Brentwood Pipeline
Brentwood, CA
9223.000.000

DATE DRILLED: 4/6/2011
HOLE DEPTH: Approx. 26½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 90 ft.

LOGGED / REVIEWED BY: R. Hildebrant / SH
DRILLING CONTRACTOR: West Coast Exploration
DRILLING METHOD: Solid Flight Auger
HAMMER TYPE: 140 lb. Rope and Cathead

Depth in Feet	Depth in Meters	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)	Unconfined Strength (tsf) *field approx
			SILTY CLAY (CH), dark brown, stiff, moist										
	1					12					25.9		1.50*
5			SILTY CLAY (CL), olive brown, stiff, moist										
	2					24					20.7		1.75* 2.50*
			SILTY CLAY (CL), dark yellowish brown, very soft, moist, ~15-25% fine-grained sand										
10	3					16					20		0.25*
	4												
15	5		very stiff, <5% fine-grained sand			34							3.00*
20	6		very stiff to hard, with white veinlets, ~5-15% fine-grained sand			42							3.25* 4.50*
	7												
25													

LOG OF BORING 1-B2

ENGEO INCORPORATED

Geotechnical Exploration
City of Brentwood Pipeline
Brentwood, CA
9223.000.000

DATE DRILLED: 4/6/2011
HOLE DEPTH: Approx. 26½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 90 ft.

LOGGED / REVIEWED BY: R. Hildebrant / SH
DRILLING CONTRACTOR: West Coast Exploration
DRILLING METHOD: Solid Flight Auger
HAMMER TYPE: 140 lb. Rope and Cathead

Depth in Feet	Depth in Meters	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)	Unconfined Strength (tsf) *field approx
	8		SILTY CLAY (CL), dark yellowish brown, very soft, moist, ~15-25% fine-grained sand becomes wet, soft			13							0.75*
			CLAYEY SAND (SC), dark yellowish brown, loose, wet, fine- to coarse-grained sand										

Bottom of boring at approximately 26½ feet below grade.
Groundwater encountered at 25 feet during drilling.

LOG OF BORING 1-B3

ENGEO INCORPORATED

Geotechnical Exploration
City of Brentwood Pipeline
Brentwood, CA
9223.000.000

DATE DRILLED: 4/6/2011
HOLE DEPTH: Approx. 21½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 93 ft.

LOGGED / REVIEWED BY: R. Hildebrant / SH
DRILLING CONTRACTOR: West Coast Exploration
DRILLING METHOD: Solid Flight Auger
HAMMER TYPE: 140 lb. Rope and Cathead

Depth in Feet	Depth in Meters	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)	Unconfined Strength (tsf) *field approx
			SILTY CLAY (CH), dark brown, stiff, ~5-10% frounded gravel, <5% fine-grained sand										
	1					14					23.9		1.25*
5			glass in sample										
			SILTY CLAY (CL), dark yellowish brown, stiff to very stiff, moist, ~5-10% fine-grained sand			27					18.6		2.25*
	2												
			SILTY SAND (SM), yellowish brown, medium dense, moist, medium-grained sand, ~5-10% fine gravel										
10	3					14					7.7		
			SILTY CLAY (CL), dark yellowish brown, stiff to very stiff, moist, ~5-10% fine-grained sand										1.50*
	4												
15			with white veinlets, very stiff, ~5-10% fine-grained sand			30							2.75* 3.00*
	5												
	6												
20						34							3.00*
			Bottom of boring at approximately 21½ feet below grade. Groundwater encountered at 21 feet during drilling.										

LOG OF BORING 1-B4

ENGEO INCORPORATED

Geotechnical Exploration
City of Brentwood Pipeline
Brentwood, CA
9223.000.000

DATE DRILLED: 4/6/2011
HOLE DEPTH: 4.5 ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 93 ft.

LOGGED / REVIEWED BY: R. Hildebrant / SH
DRILLING CONTRACTOR: ENGEO Incorporated
DRILLING METHOD: Hand Auger
HAMMER TYPE: N/A

Depth in Feet	Depth in Meters	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)	Unconfined Strength (tsf) *field approx
			SILTY CLAY (CH), dark brown, stiff, moist, with rootlets										
	1	☒	SILTY CLAY (CL), dark yellowish brown, stiff, moist, with rootlets										
			Bottom of boring at 4½ feet below grade. No groundwater encountered during drilling.										

LOG OF BORING 1-B5

Geotechnical Exploration
City of Brentwood Pipeline
Brentwood, CA
9223.000.000

DATE DRILLED: 4/6/2011
HOLE DEPTH: 4.5 ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 120 ft.

LOGGED / REVIEWED BY: R. Hildebrant / SH
DRILLING CONTRACTOR: ENGEO Incorporated
DRILLING METHOD: Hand Auger
HAMMER TYPE: N/A

Depth in Feet	Depth in Meters	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)	Unconfined Strength (tsf) *field approx
			SILTY CLAY (CL), olive brown, stiff, moist										
			SILTY CLAY (CL), dark yellowish brown, stiff, moist										
	1												
			Bottom of boring at 4½ feet below grade. No groundwater encountered during drilling.										

LOG OF BORING 1-B6

ENGEO INCORPORATED

Geotechnical Exploration
City of Brentwood Pipeline
Brentwood, CA
9223.000.000

DATE DRILLED: 4/6/2011
HOLE DEPTH: 4.5 ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 126 ft.

LOGGED / REVIEWED BY: R. Hildebrant / SH
DRILLING CONTRACTOR: ENGEO Incorporated
DRILLING METHOD: Hand Auger
HAMMER TYPE: N/A

Depth in Feet	Depth in Meters	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)	Unconfined Strength (tsf) *field approx
	1	☒	SILTY CLAY (CH), dark brown, stiff, moist, with organics										
			Bottom of boring at 4½ feet below grade. No groundwater encountered during drilling.										

APPENDIX B

Laboratory Test Results

9223.000.000
April 22, 2011

MOISTURE CONTENT DETERMINATION
ASTM 2216

SAMPLE NO.:	1-B2	1-B2	1-B2	1-B3	1-B3	1-B3		
DEPTH:	2.5	6	10.5	2.5	6	10.5		
% MOSTURE:	**25.9**	**20.7**	**20.0**	**23.9**	**18.6**	**7.7**		

ENGEO
Expect Excellence
2010 Crow Canyon Place Suite 250, San Ramon, CA 94583 (925) 866-9000

Project No. 9223.000.000
Date: April 15, 2011
Tested By:JRB Reviewed By:GC

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 04/13/2011
Date Submitted 04/08/2011

To: Randy Hildebrant
Engeo Inc.
2010 Crow Canyon Place,Ste250
San Ramon, CA 94583

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 9223/C.OF BRENTWOOD Site ID : 1-B1 @ 4'.
Your purchase order number is 9223.00.
Thank you for your business.

* For future reference to this analysis please use SUN # 59816-122071.

EVALUATION FOR SOIL CORROSION

Soil pH	7.95		
Minimum Resistivity	0.43 ohm-cm (x1000)		
Chloride	179.6 ppm	00.01796	%
Sulfate	394.8 ppm	00.03948	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 04/13/2011
Date Submitted 04/08/2011

To: Randy Hildebrant
Engeo Inc.
2010 Crow Canyon Place,Ste250
San Ramon, CA 94583

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 9223/C.OF BRENTWOOD Site ID : 1-B3 @ 5.5'.
Your purchase order number is 9223.00.
Thank you for your business.

* For future reference to this analysis please use SUN # 59816-122072.

EVALUATION FOR SOIL CORROSION

Soil pH	7.54	
Minimum Resistivity	1.10 ohm-cm (x1000)	
Chloride	14.4 ppm	00.00144 %
Sulfate	20.2 ppm	00.00202 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 04/13/2011
Date Submitted 04/08/2011

To: Randy Hildebrant
Engeo Inc.
2010 Crow Canyon Place,Ste250
San Ramon, CA 94583

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 9223/C.OF BRENTWOOD Site ID : 1-B4 @ 3.5'.
Your purchase order number is 9223.00.
Thank you for your business.

* For future reference to this analysis please use SUN # 59816-122073.

EVALUATION FOR SOIL CORROSION

Soil pH	7.31		
Minimum Resistivity	0.72 ohm-cm (x1000)		
Chloride	83.0 ppm	00.00830	%
Sulfate	137.9 ppm	00.01379	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 04/13/2011
Date Submitted 04/08/2011

To: Randy Hildebrant
Engeo Inc.
2010 Crow Canyon Place,Ste250
San Ramon, CA 94583

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 9223/C.OF BRENTWOOD Site ID : 1-B5 @ 4'.
Your purchase order number is 9223.00.
Thank you for your business.

* For future reference to this analysis please use SUN # 59816-122074.

EVALUATION FOR SOIL CORROSION

Soil pH	7.80		
Minimum Resistivity	1.69 ohm-cm (x1000)		
Chloride	14.9 ppm	00.00149	%
Sulfate	30.8 ppm	00.00308	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11353 Pyrites Way, Suite 4
Rancho Cordova, CA 95670
(916) 852-8557

Date Reported 04/13/2011
Date Submitted 04/08/2011

To: Randy Hildebrant
Engeo Inc.
2010 Crow Canyon Place,Ste250
San Ramon, CA 94583

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 9223/C.OF BRENTWOOD Site ID : 1-B6 @ 4'.
Your purchase order number is 9223.00.
Thank you for your business.

* For future reference to this analysis please use SUN # 59816-122075.

EVALUATION FOR SOIL CORROSION

Soil pH	7.53	
Minimum Resistivity	1.07 ohm-cm (x1000)	
Chloride	15.1 ppm	00.00151 %
Sulfate	66.5 ppm	00.00665 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

APPENDIX C

Previous Explorations Boring Logs

9223.000.000
April 22, 2011

DATE OF BORING: November 15, 2000

SURFACE ELEVATION: Approx. 100 feet (30 meters)

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0								
	1	2-1		SILTY SANDY CLAY (CL), light to medium brown, moist, medium stiff.	7	0.5	95	19
5		2-2		Same as above, 63.9 Percent Passing No. 200 Sieve.	4			17
	2							
10	3	2-3		SILTY CLAY (CL), medium brown, moist, very stiff, with thin layers of sandy clay.	25	2.5*	106	18
	4							
15		2-4		SILTY CLAY (CL), light to medium brown, moist, hard, trace sand.	49	3.5*		
	5							
20	6	2-5		CLAYEY fine SAND to SANDY CLAY (SC-CL), light to medium brown, moist, medium dense.	17			
	7							
25		2-6		SILTY SANDY CLAY (CL), medium brown, moist, very stiff, minor gravel (1 inch diameter).	40	3.5*	109	20
	8							
30	9	2-7		▽ Same as above with gravel.	74	4.0*		
	10							
35		2-8		SANDY CLAY (CL), light brown, moist, very stiff, some fine sand.	55			
	11			Bottom of boring at approximately $34^1/_2$ feet. Ground water encountered at 29 feet during drilling.				

MET 5122.GPJ 12/7/00

ENGEO INCORPORATED

MAGGIORE PROPERTIES

BRENTWOOD, CALIFORNIA

BORING NO.: B-2

DATE: December 2000

PROJ. NO.: 5122.5.001.01

CHECKED BY PLG

FIGURE NO. 6

DATE OF BORING: November 15, 2000

SURFACE ELEVATION: Approx. 98 feet (30 meters)

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0								
	1	3-1		SANDY CLAY (CL), medium dark brown, stiff, dry to moist, trace sand, trace roots.	16	+4.5*		
5		3-2		SILTY SAND (SM), medium brown, loose to medium dense, moist.	8			
	2							
				SILTY CLAY (CL), medium brown, moist, hard, trace fine sand.				
10	3	3-3			39	+4.5*	110	19
	4							
15		3-4			41	+4.5*		
	5							
20	6	3-5		SILTY SAND (SM), light brown, moist, medium dense to dense. 30.8 Percent Passing No. 200 Sieve.	46			
		3-6			25			
	7							
25								
	8							
				▽				
	9							
30		3-7		SANDY SILTY CLAY (CL), orange brown, moist, stiff.	17			
		3-8		78.4 Percent Passing No. 200 Sieve.	10	2*		
	10			Bottom of boring at approximately at 32 feet. Ground water encountered at 29 feet during drilling.				
35								
	11							

MET 5122.GPJ 12/7/00

ENGEO INCORPORATED

MAGGIORE PROPERTIES

BRENTWOOD, CALIFORNIA

BORING NO.: B-3

DATE: December 2000

PROJ. NO.: 5122.5.001.01

CHECKED BY PLG

FIGURE NO. 7

DATE OF BORING: November 15, 2000

SURFACE ELEVATION: Approx. 103 feet (31 meters)

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0								
	1	4-1		SANDY CLAY (CL), with sand, light brown, moist, very stiff, trace roots.	17	+4.5*	97	16
5		4-2			17			
	2							
		4-3		SILTY CLAY (CL), medium brown, moist, very stiff.	29	+4.5*		
10	3							
	4							
		4-4			24		107	21
15	5							
		4-5		SILTY CLAY (CL), light brown, moist, very stiff, some gravel and caliche, possible weathered bedrock.	39	+4.5*	104	24
20	6							
	7							
		4-6			41	+4.5*		
25				Bottom of boring at approximately 24 1/2 feet. Ground water not encountered during drilling.				
	8							
30	9							
	10							
35	11							

MET 5122.GPJ 12/7/00

ENGEO INCORPORATED

MAGGIORE PROPERTIES

BRENTWOOD, CALIFORNIA

BORING NO.: B-4

DATE: December 2000

PROJ. NO.: 5122.5.001.01

CHECKED BY PLG

FIGURE NO. 8

DATE OF BORING: November 4, 2002

SURFACE ELEVATION: Approx. 106 feet (32 meters)

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0				SANDY CLAY (CL), brown, hard, moist, trace sand.				
		1-1			15	+4.0*	112.4	11.8
	1				10			
5								
	2	1-2			35		114.2	15.1
				Lighter.				
10	3			SANDY CLAY (CL), light brown, hard, moist, plastic.				
		1-3			36	4.0*	111.4	16.9
	4							
15								
	5	1-4		Poorly-graded SILTY SAND (SP), light brown, medium dense, wet, mostly fine grained, some clay particles.	16			8.5
				More gravel.				
				▽				
20	6							
		1-5		SAND more gravelly (SP), wet, coarse grained, angular, cobble material.	31			21.1
	7							
25				SANDSTONE, light brown, moderately weathered, bedrock. Very dense sand, weathered sandstone.	50/2"			
	8			Bottom of boring at approximately 26 feet. Groundwater encountered at 19 1/2 feet during drilling.				
	9							
30								

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

MONTELENA II

BRENTWOOD, CALIFORNIA

BORING NO.: B-1

LOGGED BY: J. Buck

PROJ. NO.: 5122.4.002.01

CHECKED BY: DRH

FIGURE NO. 5

0541 5122400201_MONTELENA2.GPJ 12/18/02

DATE OF BORING: November 4, 2002

SURFACE ELEVATION: Approx. 104 feet (32 meters)

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0				SILTY CLAY (CH), dark brown, soft, moist, highly plastic.				
		2-1			9	1.0*	108.5	18.5
	1	2-2		SILTY CLAY (CH), dark brown, soft, moist, loose.	6		101.4	22.6
5				SILTY CLAY to CLAYEY SILT (CH-ML), dark brown, very stiff, moist, highly plastic.				
	2	2-3			16	1.5*		
10	3			SILTY CLAY (CH), light brown, very stiff, moist, plastic, trace of sand.				
		2-4			22	+4.0*	109.3	18.3
	4							
15				SILTY CLAY (CH), light brown, very stiff, moist, trace sand.				
	5	2-5			36	+4.0	109.1	21.0
	6							
20		2-6		Well-graded SAND with some gravel (SW), olive brown, dense, wet, fine to very coarse-grained sand, with some fine gravel.				
		2-7			28			
	7			Bottom of boring at approximately 21 $^{1}/_{2}$ feet. Groundwater not encountered during drilling.				
25								
	8							
	9							
30								

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

MONTELENA II

BRENTWOOD, CALIFORNIA

BORING NO.: B-2

LOGGED BY: J. Buck

PROJ. NO.: 5122.4.002.01

CHECKED BY DRH

FIGURE NO. 6

0541 5122400201_MONTELENA2.GPJ 12/18/02

DATE OF BORING: November 4, 2002

SURFACE ELEVATION: Approx. 107 feet (32 meters)

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0				SILTY CLAY (ML-CL), dark brown, very stiff, moist, plastic.				
		3-1			19	+4.0*	105.7	19.6
	1	3-2		Lighter.	10			
5				SANDY CLAY (CL), brown with reddish upper color, very stiff, 4 to 4.4 inch cobble size, subrounded material.				
	2	3-3			10	+4.0*	63.6	7.6
				Lighter sand?				
10	3	3-4		SANDY CLAY (SC), light brown, very stiff to hard, moist, fine grained with some claystone.	50/4.5"		89.0	22.0
	4							
15		3-5		Poorly-graded SAND (SP), dark brown, very dense, wet, fine to coarse grained.	50/4"			
	5							
20	6	3-6		Grade to friable sandstone.	60/5"		83.4	34.1
				Bottom of boring at approximately 20 $^{1}/_{2}$ feet. Groundwater not encountered during drilling.				
	7							
25								
	8							
	9							
30								

ENGEO INCORPORATED
1971 - 2001 * 30 YEARS OF EXCELLENCE

MONTELENA II

BRENTWOOD, CALIFORNIA

BORING NO.: B-3

LOGGED BY: J. Buck

PROJ. NO.: 5122.4.002.01

CHECKED BY DRH

FIGURE NO. 7

0541 5122400201_MONTELENA2.GPJ 12/18/02

DATE OF BORING: April 16, 2004

SURFACE ELEVATION: Approx. 88 feet (27 meters)

DEPTH (FEET)	DEPTH (METERS)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	BLOWS/FT.	qu UNCON STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0				Cut alfalfa.				
		1-1		CLAY (CH), dark brown, moist, hard, trace sand.	45		111	16.9
	1							
5		1-2			54		114	15.0
	2			SILTY SAND (SM), light brown, moist, medium dense, fine-grained sand.				
10	3	1-3			29		101	9.0
	4							
15	5			SILTY CLAY (CL), brown, wet, hard.				
20	6	1-4			43	3.5*	112	17.7
				Bottom of boring at approximately 21 $^{1}/_{2}$ feet. Groundwater not encountered during drilling.				
25	7							
	8							
30	9							
	10							

ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971

S AND S FARM/HANCOCK PROPERTIES

BRENTWOOD, CALIFORNIA

BORING NO.: B-1

LOGGED BY: Z. Crawford

PROJ. NO.: 5535.4.008.01

CHECKED BY SH

FIGURE NO. A-1

ENGEO_BORELOG 5535400801_S&SFARMHANCOCKPROPERTY.GPJ 4/30/04