ATTACHMENT 9

Robles Engineering, Inc.
Geotechnical Consultants

GEOLOGIC AND SOILS ENGINEERING INVESTIGATION FOR PROPOSED RESIDENCE
APN 5662-019-011
910 LAIRD DRIVE
GLENDALE, CALIFORNIA

NOVEMBER 23, 2016 RE 16-1002

FOR

VISTA ENTERPRISES
3169 KIRKHAM DRIVE
GLENDALE, CA 91206

GEOLOGIC AND SOILS ENGINEERING

INVESTIGATION FOR PROPOSED RESIDENCE

APN 5662-019-011

910 LAIRD DRIVE

GLENDALE, CALIFORNIA

INTRODUCTION

The following report summarizes the findings of our geologic and soils engineering investigation performed at the site located at 910 Laird Drive in the City of Glendale. The report includes a description and an evaluation of the soil and geologic materials, discusses the geologic structural conditions, and provides geologic and soils engineering recommendations for the construction of the proposed residence.

This report is intended for submittal to the appropriate governmental authorities that control the issuance of necessary permits and to aid in the design and completion of the proposed development by providing recommendations for site preparation, foundations, retaining walls, pool shell, temporary excavations, on-grade slabs, and surface drainage control.

Purpose

The primary purpose of this investigation was to provide our best estimate of the geotechnical factors that pertain to the gross stability of the proposed residence, and to evaluate alternatives for a foundation system.

SCOPE OF WORK

The scope of our investigation involved the completion of the following:

1. Review of available general geologic data including:

   a) Dibblee, T.W., Jr., 1989, Geologic Map of the Pasadena Quadrangle, Los Angeles County, California; Dibblee Geological Foundation, Map DF-23, Scale = 1:24,000.

   b) California Division of Mines and Geology, Special Publication 117A, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California, 108 p.

   c) Probabilistic Seismic Hazard Assessment for the State of California, California Division of Mines and Geology Open File-Report 98-05, 1998, 33 p., and Appendixes A and B.

   d) State of California, Seismic Hazard Zones, Pasadena Quadrangle, California Department of Conservation, Division of Mines and Geology, Released March 25, 1999, Scale 1"=2000'.

2. Research and review of the public record file, available geologic reports and review agency correspondence prepared for the subject properties. Other geologic documents may be present for the area which could alter the findings and recommendations presented herein. Research of the public record system is not a guarantee all available geologic data was reviewed or present at the time of our research. A list of reviewed documents is provided below.

   According to the review agency database "No Matching Records Found" for the subject properties.

3. Excavation and detailed logging of four (4) exploratory test pits.

4. Geotechnical analysis of field and laboratory data.

5. Preparation of a Geotechnical Map, Geologic Cross-Sections, and various graphs.

6. Presentation of our procedures, findings, and recommendations.

PROPOSED DEVELOPMENT

The findings and recommendations contained in this report are based on information provided by the project architect. The proposed development will consist of the construction of a new two-level residence and swimming pool at the subject site (see Plates 1 and CS-1). Retaining walls 12-feet in height will be necessary to achieve the desired grades. All structures should be founded on footings bearing into competent bedrock. Final site development plans await the recommendations of this report.

SITE LOCATION & DESCRIPTION

The property is located at the terminus of Laird Drive, east of its intersection with Chevy Chase Drive, in the City of Glendale. The site is legally described as APN 5662-019-011.

The subject site is topographically situated at the base of an east-west trending secondary ridge in the southern foothills of the San Rafael Hills in the city of Glendale, California. The site consist of an undeveloped ascending slope approximately 200-feet in height.

Vegetation on the site consists of sporadic ground cover, native chaparral, scattered bushes, and several mature trees. Drainage of the majority of the slope is via uncontrolled sheet flow down the existing gradient and infiltration into the subsurface soils.

FIELD EXPLORATION

The site was explored on November 2, 2016 by excavation and field mapping of four (4) hand dug test pits to a maximum depth of 5-feet. The earth materials were logged in detail and are presented in the Log of Test Pits (Plate TP-1). On-site and nearby bedrock exposures were carefully examined. The approximate distribution of the earth materials on the site and vicinity and the test pit locations are shown on Plate 1.

EARTH MATERIALS

The earth materials encountered in the area of the proposed structures at the site consist of residual soil and bedrock.

Residual Soil (Rs)

Residual soil consisting of brown silty sand was encountered mantling the upper natural portion of the slope. The soil is dry, loose to medium dense, fine grained, with few small bedrock fragments and roots. The maximum observed thickness of the soil is approximately 1-foot in the area of the proposed development, although this thickness may vary across the site. The residual soil is not considered suitable for foundation or slab support or as a base to receive certified compacted fill.

Bedrock (Kg)

Bedrock consisting of granite was encountered in the exploratory test pit excavations at the site and is well exposed along road-cuts on Chevy Chase Drive. The granite is typically hard, dense and weathered in the upper few feet. The granite becomes increasingly dense with depth, and ranges in color of various shades of gray and weathers to brown. The bedrock is considered suitable for foundation support of the proposed structures.

ENGINEERING GEOLOGY

The engineering geologic factors evaluated include geologic planes of weakness, excavation characteristics, landslides, and groundwater.

Geologic Planes of Weakness

The granitic bedrock at the site was observed to be hard and essentially massive. Fracturing of the outer weathered surface is slightly to moderately well developed. No significant through-going geologic planes of weakness were observed in the bedrock.

Joints and Fractures

Bedrock at the site was observed to be slightly to moderately fractured. Fractures are steeply dipping, randomly oriented, and discontinuous where observed. Fractures are not expected to adversely effect the development of the site.

Excavation Characteristics

Bedrock at the site was observed to be hard and slightly to moderately fractured. It is anticipated that these materials can be excavated using standard excavation equipment, although jackhammering and/or coring may be required locally.

Landslides

Ancient or recent landslides were not observed on the property. In addition, our examination of slopes on the property did not reveal the presence of past surficial slope failures.

Groundwater

No groundwater seepage was observed on the site or in our exploratory excavations. The groundwater level appears to be substantially below the level of the proposed development and grading. It should be understood that localized perched groundwater may exist at shallower depths depending upon seasonal rainfall amounts.

SEISMIC CONDITIONS

No known faults with potential for surface rupture underlie the site. Nor is the site located within an Alquist Priolo Special Studies Zone.

The site appears to lie within a Zone of Required Investigation (potential seismically-induced landslide) defined by the State of California per the Seismic Hazards Mapping Act of 1990. However, the proposed structures do not meet the definition of a "project" which require a detailed analysis or mitigation in accordance with the code.

Seismic Design

It is our opinion that future structures should be designed in accordance with the current seismic building code as determined by the structural engineer. The subject site is located within Site Class C per the California Building Code. Based on the United States Geologic Survey mapping, the following values of short and long period accelerations are recommended for the Maximum Considered Earthquake (MCE). The Design Basis Earthquake (DBE) spectral acceleration parameters presented on the following table for Site Class C, generated by the computer program Earthquake Ground Motion Parameter Calculator by the USGS, may be utilized for seismic design:

Site location (latitude, longitude) : (34.1605, 118.2128)				
Spectral Period, T (second)	Site Class B MCE spectral acceleration (g)	Site Class C MCE spectral acceleration (g)		Site Class C DBE spectral acceleration (g)
0.2	$S_s = 2.901$	$Fa = 1.0$	$S_{MS} = 2.901$	$S_{DS} = 1.934$
1.0	$S_1 = 1.012$	$F_V = 1.3$	$S_{M1} = 1.315$	$S_{D1} = 0.877$

Ground shaking resulting from a moderate to major earthquake (Magnitude 6.0 or greater) can be expected during the life span of the proposed structure. Property owners and the general public should be aware that any structure or slope in the southern California region could be subject to significant damage as a result of a moderate or major earthquake. The potential exists throughout southern California for strong ground motion similar to that which struck the Los Angeles region during the January 17, 1994, Northridge Earthquake. Several such destructive earthquakes have struck southern California during the span of recorded history.

Present building codes and construction practices, and the recommendations presented in this report are intended to minimize structural damage to buildings and loss of life as a result of a moderate or a major earthquake. They are not intended to totally prevent damage to structures, graded slopes and natural hillsides due to moderate or major earthquakes. While it may be possible to design structures and graded slopes to withstand strong ground motion, the construction costs associated with such designs are usually prohibitive, and the design restrictions may be severely limiting. Earthquake insurance is often the only economically feasible form of protection for your property against major earthquake damage. Damage to sidewalks, steps, decks, patios and similar exterior improvements can be expected as these are not normally controlled by the building code.

Major foundation problems are not anticipated as a result of earthquake induced liquefaction, fault ground rupture or displacement, and differential settlement of natural earth materials, provided the foundation system is constructed as herein recommended, within the limitations presented above.

LABORATORY TESTING

Laboratory tests were conducted on representative samples by EGLAB, Inc., to determine certain physical properties of the earth materials. Field moisture content, in-situ density, and shear strength characteristics were determined from these tests. The laboratory test results are presented in the Appendix B.

We have reviewed and concur with the laboratory data conducted by EGLAB, Inc. (Appendix B). We are accepting geotechnical responsibility for use of the referenced laboratory data.

SLOPE STABILITY

The gross and surficial stability of the slope at the subject site has been analyzed using Taylor's Method of Critical Height (Appendix A-1). Residual shear strengths for the oils and bedrock were utilized for a slope angle of 33 degrees which represents the steepest portion of the existing ascending slope. Based on the calculated stable (1.5 factor of safety) critical height, the existing/proposed slopes on-site are considered grossly and surficially stable.

CONCLUSION

Based on the findings of our investigation, the site is considered to be suitable from a geologic and soils engineering standpoint for construction of the proposed residence and swimming pool, provided that the recommendations included herein are followed and integrated into the final development/grading plans.

RECOMMENDATIONS

Foundation and Building Setback

Setbacks from the top or toe of slopes steeper than 3:1 in ratio should comply with the minimum requirements of the controlling governmental agency.

The base of all new foundations should be set back a minimum horizontal distance equivalent to one-third of the slope height (H/3). This horizontal distance should be measured from the outer face of the foundation to the competent face of the adjacent descending slope. Foundation setback distance should be at least 5-feet, but needs not exceed 40-feet.

All structures should be set back from the toe of the ascending slope a minimum horizontal distance equivalent to one-half of the height of the ascending slope (H/2). Building setback distance should be a minimum of 3-feet, but needs not exceed 15 feet.

Foundations

Spread Footings

Spread footings are adequate for foundation support of the proposed structures where depth to bedrock is shallow (less than 5-feet) and the foundation setback distance is not an issue. All foundations should bear entirely in competent bedrock. Continuous footings may be designed using a bearing pressure of 3500 psf for bedrock. They should be a minimum of 12-inches in width and 12- and 18-inches (one-story and two-story, respectively) into bearing material. Due to the presence of residual soil, deepened footings may be needed to insure all footings are embedded in bedrock.

Independent footings may be designed using a bearing pressure of 4500 psf. The dimensions on independent footings should be a minimum of 2-feet square and founded at least 2-feet into bearing material. A 20 percent increase is allowable for each additional foot of excavation depth and 10 percent increase for each additional foot of excavation width up to a maximum value of 8000 psf.

Friction Piles

Where foundation setback is an issue ,friction piles may be used to support the proposed structures. Piles should be a minimum of 24-inches in diameter and a minimum of 10-feet into bedrock or that depth necessary to achieve the required foundation setback distance (whichever is deeper). Piles may be assumed fixed at 3-feet into bedrock. The piles may be designed for a skin friction of 800 psf for that portion of pile in contact with the bedrock. All piles should be connected with grade beams and designed within a tolerable amount of deflection, determined by the structural engineer. All friction pile excavations should be periodically observed by a representative of this firm.

General

The bearing pressure given is for the total of dead and frequently applied live loads and may be increased by one-third for short duration loading which includes the effects of wind or seismic forces.

Lateral Design

Resistance to lateral loading may be provided by friction acting at the base of foundations and by passive earth pressure within the bearing material. An allowable coefficient of friction of and 0.4 may be used with the dead load forces.

Passive earth pressure may be computed as an equivalent fluid having a density of 400 pcf for bedrock with a maximum earth pressure of 6000 psf . When combining passive and friction for lateral resistance, the passive component should be reduced by one-third. Passive pressure above a plane measured 5-feet horizontally from the bedrock slope should be neglected. For friction piles, the recommended passive earth pressure may be doubled provided that the pile spacing exceeds 2.5 pile diameters on center.

Foundation Settlement

Settlement of the new foundation system is expected to occur on initial load application. The maximum settlement is expected to be ½ inch. Differential settlement is not expected to exceed ¼ inch within a span of 30-feet.

Slabs Floor

Concrete floor slabs should be supported entirely on competent bedrock or new certified compacted fill, but not spanning both, and should be reinforced with a minimum of #4 rebar spaced at a minimum distance of 16-inches on center each way. Slabs to be covered with flooring should be protected by an acceptable plastic vapor retarder/barrier (minimum 10 mil). To prevent punctures and aid in the concrete cure, the barrier should be covered with a 3-inch layer of sand per ACI Manuel of Concrete Practice, 2006.

If removal and recompaction is not possible (due to space restriction, underground lines, etc.,) we recommend that all interior floor slabs be designed as a structural unit which transfers all loads to the foundation system. As an alternative, a raised wood floor is suggested. This, however, should also transfer all loads to the foundation system.

A minimum 4-inch-thick capillary break consisting of compacted clean graded 3/4-inch gravel should be placed below the vapor retarder/barrier if the slab level is below the surrounding finished grade.

If moisture vapor transmission is a concern to the facility owner, an expert should be consulted to provide additional recommendations for the design and construction of slabs in moisture sensitive flooring areas. Waterproofing details, application methods or effectiveness in preventing moisture intrusion are beyond the scope of our work authorization and not the responsibility of *Robles Engineering, Inc.*

Retaining Walls

Free-standing non-surcharged retaining walls, 12-feet in height or less, may be designed for active pressures per the following table:

Surface Slope of Retained Material Horizontal to Vertical	Equivalent Fluid Weight (pcf)
LEVEL	30
5 to 1	32
4 to 1	35
3 to 1	38
2 to 1	43

1 ½ to 1	55
1 to 1	80

In accordance with present day building codes an additional seismic load should be added to the retaining wall design for walls higher than 6-feet, as measured from the top of the foundation. For restrained walls, the additional loading should be applied at the mid point of the wall. For freestanding walls the additional loading should be applied at 0.4H below the top of the wall. Our earth pressure distribution diagram is attached (Plate PD-1).

All walls should be effectively waterproofed, provided with a subdrain, and backfilled to within 24-inches of the top of the wall with a 1-foot wide column of gravel. We recommend you hire a waterproofing expert to determine your waterproofing requirements and to provide inspection and approval for the same. Waterproofing details, application methods or effectiveness in preventing moisture intrusion are beyond the scope of our work authorization and not the responsibility of *Robles Engineering, Inc.* Where the backfill area is confined, the use of Caltrans Class II permeable material is recommended. The surface of the backfill should be covered by an approved filter fabric and 24-inches of compacted soil (Plates RD-1 and RD-2). The subdrainage system, including outlet locations, should be clearly shown on the building or grading plans. The contractor is responsible to insure that all subdrain outlets are constructed per plan and remain unobstructed. While all backfill should be compacted to the required density, care should be taken when working close to new walls to prevent excessive lateral pressure.

Retaining walls supporting ascending slopes should be provided with a minimum free-board of 2-feet. An open "V" drain should be placed behind the walls so that all up slope flows are directed around the proposed structures to the street or other approved disposal area.

Temporary Excavations

Vertical excavations required for retaining walls and/or removal and recompaction are anticipated to be up to 10-feet in vertical height and are expected to expose soil and bedrock. The maximum recommended height of non-surcharged temporary vertical excavations in bedrock materials is 10-feet. Excavations above this height and that portion exposing soil should be trimmed to 1:1. Excavations shall not remove the lateral support from a public way, from an adjacent property or from an existing structure.

All excavations shall be made in accordance with the regulations of the State of California, Division of Industrial Safety. These recommended temporary excavation slopes do not preclude local raveling and sloughing.

All excavations should be stabilized within 30 days of initial excavation. Water should not be allowed to pond on the top of the excavation nor to flow towards it. No vehicular surcharge should be allowed within 3 feet of the top of cut.

It is recommended that a pre-excavation site meeting be attended by the grading contractor, the soils engineer and an agency representative to discuss methods and sequence of subterranean excavation.

Swimming Pool

The proposed swimming pool should be supported entirely in competent bedrock. The pool shell should be designed for free standing conditions. All pool walls should be designed for a minimum equivalent fluid pressure of 65 pcf.

Drainage Protection

All pad and roof drainage should be collected and transferred to the street or an approved location in non-erosive drainage devices. Drainage should not be allowed to descend any slope in a concentrated manner, pond on the pad or against any foundation or retaining wall.

It is the responsibility of the contractor and ultimately the developer and/or property owner to insure that all drainage devices are installed and maintained in accordance with the approved plans, our recommendations, and the requirements of all applicable municipal agencies. This includes installation and maintenance of all subdrain outlets and surface drainage devices.

Drainage Control

Final grading shall provide positive drainage away from the footings and from the lot. Proper drainage shall also be provided away from the building footing and from the lot during construction. Maintaining a proper drainage system will minimize the shrink/swell potential of the subsoils.

Slope Maintenance

To reduce the risk of problems relating to slope instability, a program of continual slope maintenance is necessary. This maintenance program should include but need not be limited to annual cleanout of existing drainage ways, sealing of any cracks, elimination of gophers and earth burrowing rodents, maintaining low water consumptive, fire retardant, deep rooted ground cover and proper irrigation.

Hillside properties are typically subject to potential geotechnical hazards including settlement, slope failures, slumping, spalling of slopes, erosion and concentrated slopes. It must be emphasized that responsible maintenance of these slopes, and the property in general, by the owner, using proper methods, can reduce the risk of these hazards significantly.

Approval

A set of building plans should be submitted to this firm for review and approval prior to initiation of construction.

Any fill which is placed should be tested for compaction if used for engineering purposes. All cut slopes and temporary excavations should be observed by this firm. Should the observation reveal any unforeseen hazard, appropriate treatment will be recommended.

We will observe work in progress, and observe excavations and trenches. It should be understood that the contractor or others shall supervise and direct the work and they shall be solely responsible for all construction means, methods, techniques, sequences and procedures, and shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during the performance of the work.

Remarks

The conclusions contained herein are based on the findings and observations made at the subject properties and any referenced soils report. While no great variations in subsurface conditions are anticipated, if conditions are encountered during construction which appear to differ from those disclosed, *Robles Engineering, Inc.*, should be notified, so as to consider the need for modifications.

This report has been compiled for the exclusive use of **Vista Enterprises** and their authorized representatives. It shall not be transferred to, or used by, a third party, to another project or applied to any other project on this site, other than as described herein, without consent and/or thorough review by this firm.

Should the project be delayed beyond the period of <u>one year</u> after the date of this report, the site should be observed and the report reviewed to consider possible changed conditions.

This report is issued with the understanding that it is the responsibility of the owner, or his representative, to assure that the information and recommendations contained herein are called to the attention of the designers and builders for the project.

The limits of our liability for data contained in this report and warranty is presented on the following page.

Please call if you have any questions.

REGISTERED PROFESSIONAL ENGINEER
GUSTAVO ROLES
2422
Exp. 10-31-18
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Gustavo Robles, Soils Engineer & Geologist
RCE 66797, Exp. 9/30/18
CEG 2422, Exp. 10/31/18

REGISTERED PROFESSIONAL ENGINEER
GUSTAVO ROBLES
No. 66797
EXP. 9-30-18
CIVIL
STATE OF CALIFORNIA

Attachments:
- Appendix A: 4 Plates (geologic maps, sections and logs)
- Appendix A-1: 5 Plates (calculations, analyses and details)
- Appendix B: Laboratory Test Results (EGL, Inc., 2016)

CC: 1 Hard Copy (client) & 2 Hard Copies/1 Electronic Copy (review agency)

LIMITATIONS

This report is based on the development plans provided to our office. In the event that any significant changes in the design or location of the structure(s); as outlined in this report are planned, the conclusions and recommendations contained in this report may not be considered valid unless the changes are reviewed and the conclusions of this report are modified or approved by the soil engineer and geologist.

The subsurface conditions, excavations, characteristics and geologic structure described herein and shown on the enclosed cross-section(s) have been projected from individual borings or test pits placed on the subject property. The subsurface conditions and excavation characteristics, and geologic structure shown should in no way be construed to reflect any variations which may occur between these borings or test pits.

It should be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors not evident at the time measurements were made and reported herein. *Robles Engineering, Inc.*, assumes no responsibility for variations which may occur across the site.

If conditions encountered during construction appear to differ from those disclosed, this firm shall be notified so as to consider the need for modifications. No responsibility for construction compliance with the design concepts, specifications or recommendations is assumed unless on-site construction review is performed during the course of construction which pertains to the specific recommendations contained herein.

This report has been prepared in accordance with generally accepted practice. No warranties, either expressed or implied, are made as to the professional advice provided under the terms of the agreement and included in this report.

GRADING GUIDELINES

Site Clearing

Any existing brush, loose fill and porous soils shall be excavated to competent native materials. Prior to the placement of any fill soils, the exposed surface shall be scarified, cleansed of debris and recompacted to 90 percent of the laboratory standard under the direction of the Soils Engineer in accordance with the following "Placing, Spreading, and Compacting Fill Materials".

Preparation

After the foundation for the fill has been cleared, and scarified, it shall be brought to a proper moisture content and compaction to not less than 90 percent of the maximum dry density in accordance with ASTM D1557.

Materials

On-site materials may be used in the fill if cleansed of debris. Imported fill materials shall be approved by the Soils Engineer and may be obtained from any other approved source. The materials used should be free of excessive organic matter and other deleterious substances and shall not contain rocks or lumps greater than 6 inches in maximum dimension.

Placing, Spreading and Compacting Fill Materials

Fill materials shall be placed in layers which when compacted shall not exceed 6 inches in thickness. Each layer shall be spread evenly and shall be thoroughly mixed during the spreading to ensure uniformity of material and moisture of each layer.

Where the moisture content of the fill material is below the optimum value determined by the Soils Engineer, water shall be uniformly added to obtain the approximate optimum moisture content.

Where the moisture content of the fill materials is higher than the optimum value determined by the Soils Engineer, the fill materials shall be aerated by blading disking or mixing with dry materials until the optimum moisture content is obtained.

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted to not less than 90 percent of the maximum dry density in accordance with ASTM D1557. Cohesionless soil having less than 15 percent finer than 0.005 millimeters (such as base material or pea gravel) shall be compacted to a minimum of 95 percent of the maximum dry density.

Compaction shall be by sheepfoot roller, tract rolling or other types of acceptable compaction equipment of such design that they will be able to compact the fill material to the specified density. Rolling shall be accomplished while the fill material is at the specified moisture content, to ensure that the desired density has been obtained. The final surface of the areas to review slabs-on-grade should be rolled to a dense smooth surface.

GRADING GUIDELINES *(Continued)*

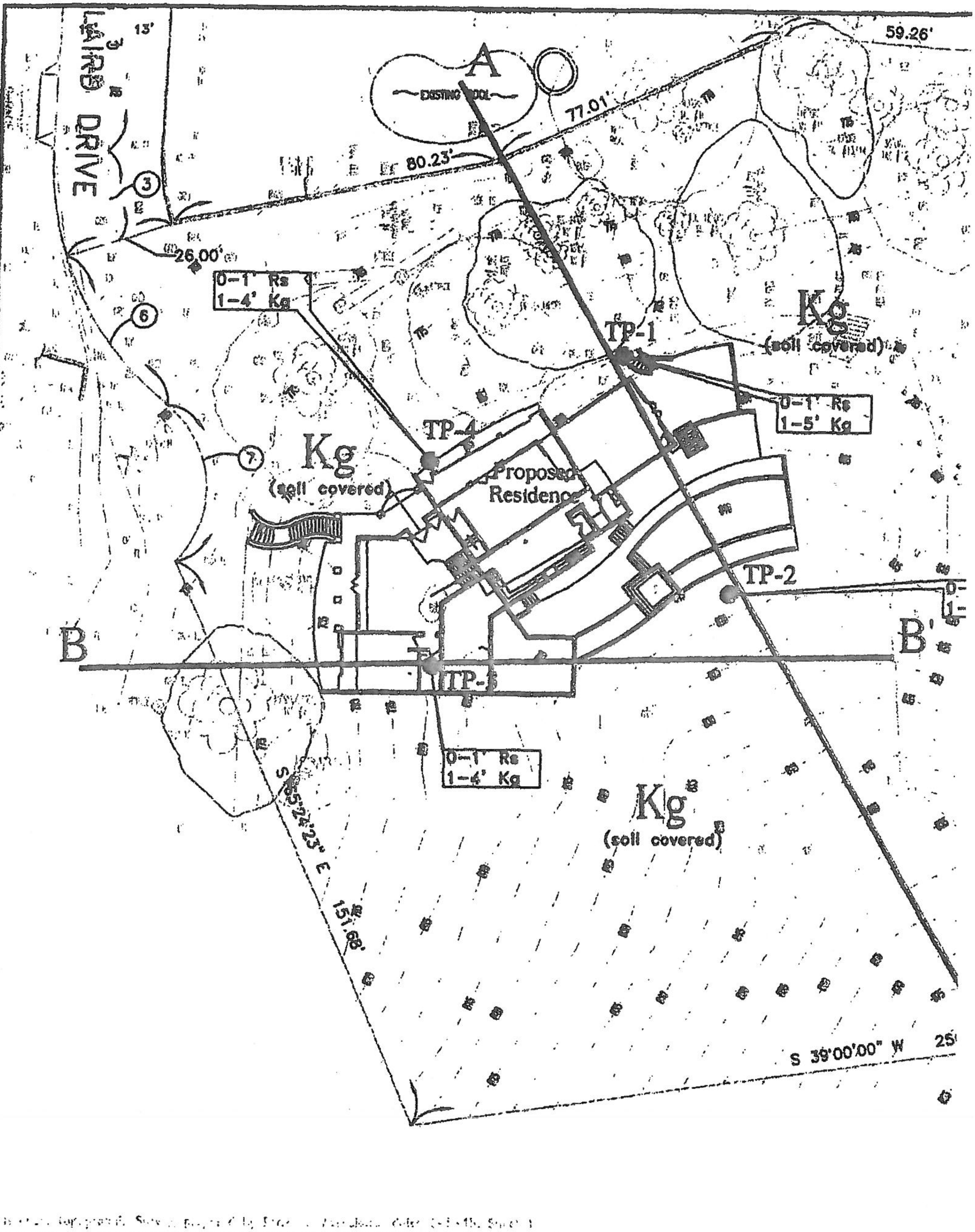
Field density tests shall be made by the Soils Engineer at intervals not to exceed 2 feet of fill height. Where sheepfoot rollers are used, the soil may be disturbed to a depth of several inches and density reading shall be taken in the compaction material below the disturbed surface. When these readings indicate the density of any fill or portion thereof is below the required 90 percent density, the particular layer of portion shall be reworked until the required density has been obtained.

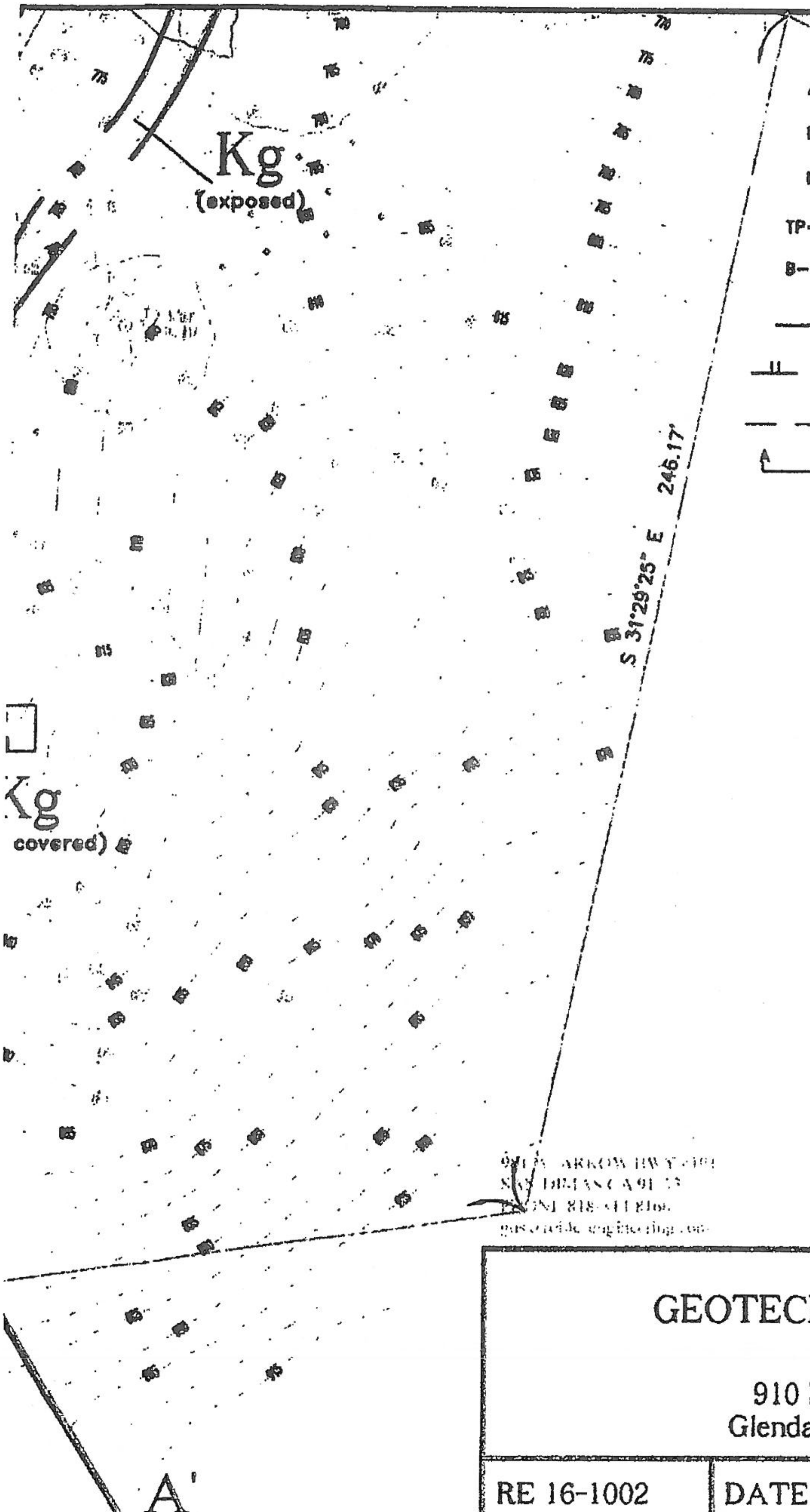
The grading specifications should be a part of the project specifications.

The Soils Engineer shall review the grading plan prior to grading.

APPENDIX A

(geologic maps, sections and logs)


LAIRD DRIVE
13'
59.26'
A
EXISTING POOL
77.01'
80.23'
26.00'
3
6
7
0–1' Rs
1–4' Kg
TP-1
Kg
(soil covered)
0–1' Rs
1–5' Kg
TP-4
Kg
(soil covered)
Proposed
Residence
TP-2
B
B'
TP-3
0–1' Rs
1–4' Kg
Kg
(soil covered)
S 65°24'23" E
151.68'
S 39°00'00" W



EXPLANATION

Af	ARTIFICIAL FILL
Rs	RESIDUAL SOIL
Kg	BEDROCK – GRANITE
TP-1 ●	TEST PIT LOCATION
B-1 ⌖	BORING LOCATION
15	STRIKE AND DIP OF BEDDING
	APPROXIMATE LIMITS OF FILL
	APPROXIMATE GEOLOGIC CONTACT
A — A'	LINE OF GEOLOGIC CROSS SECTION

NORTH

SCALE: 1" = 30'

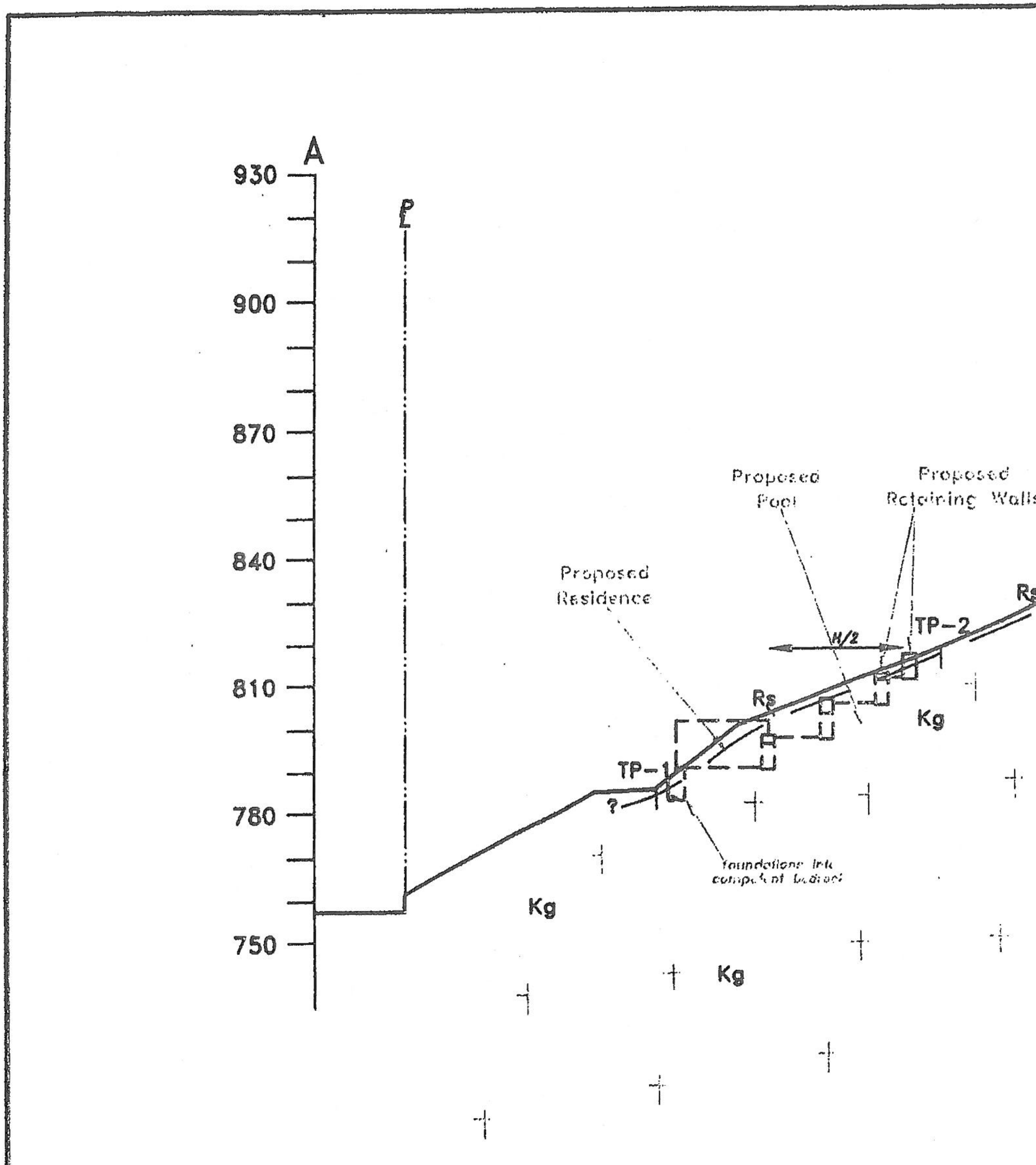
0 15 30 45 60

Robles Engineering, Inc.
Geotechnical Consultants

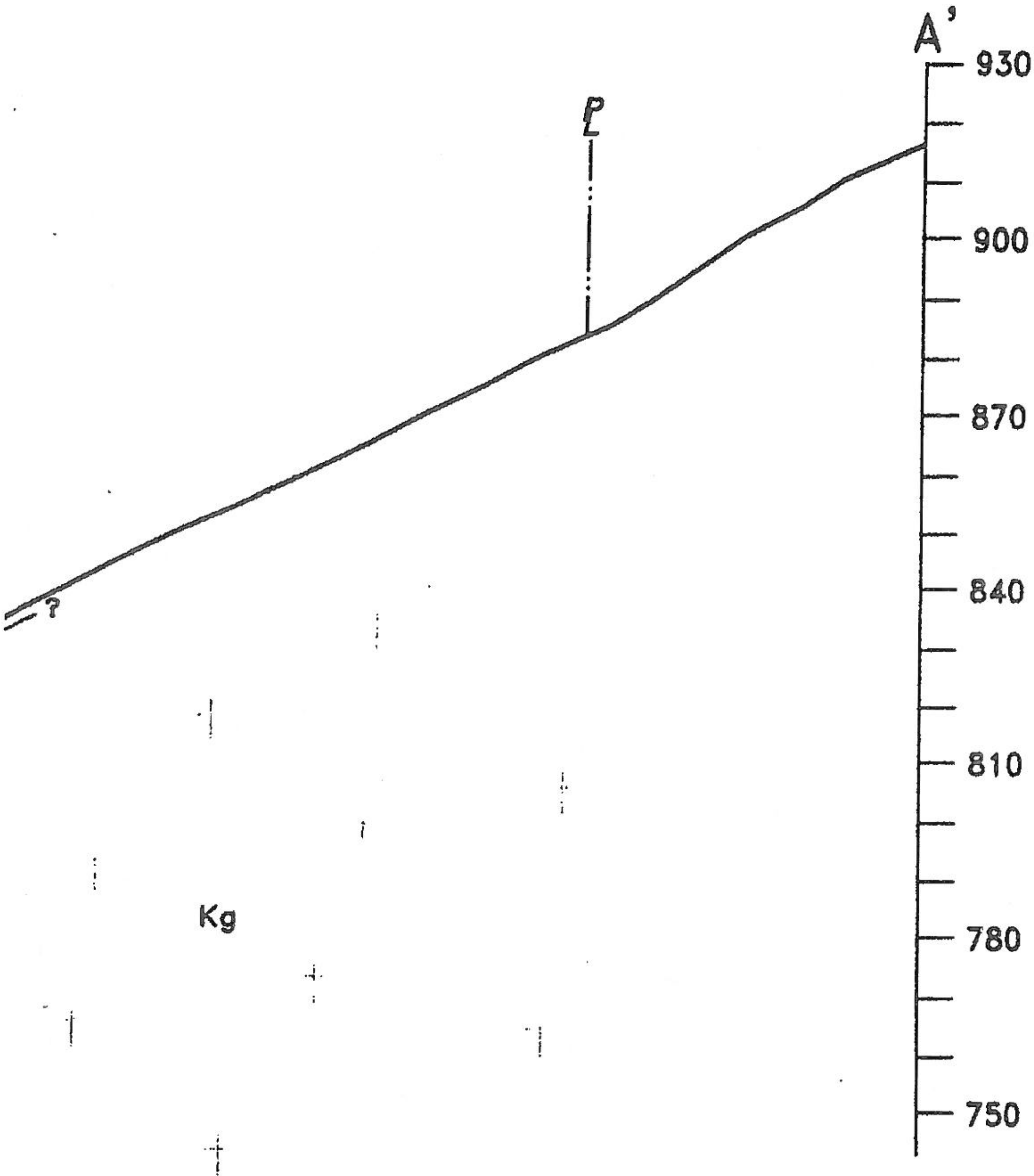
GEOTECHNICAL MAP

910 Laird Drive
Glendale, California

RE 16-1002	DATE: Nov, 2016	PLATE 1



A
930
900
870
840
810
780
750
Proposed Residence
Proposed Pool
Proposed Retaining Walls
H/2
TP-1
TP-2
Rs
Rs
Kg
Kg
Kg
?

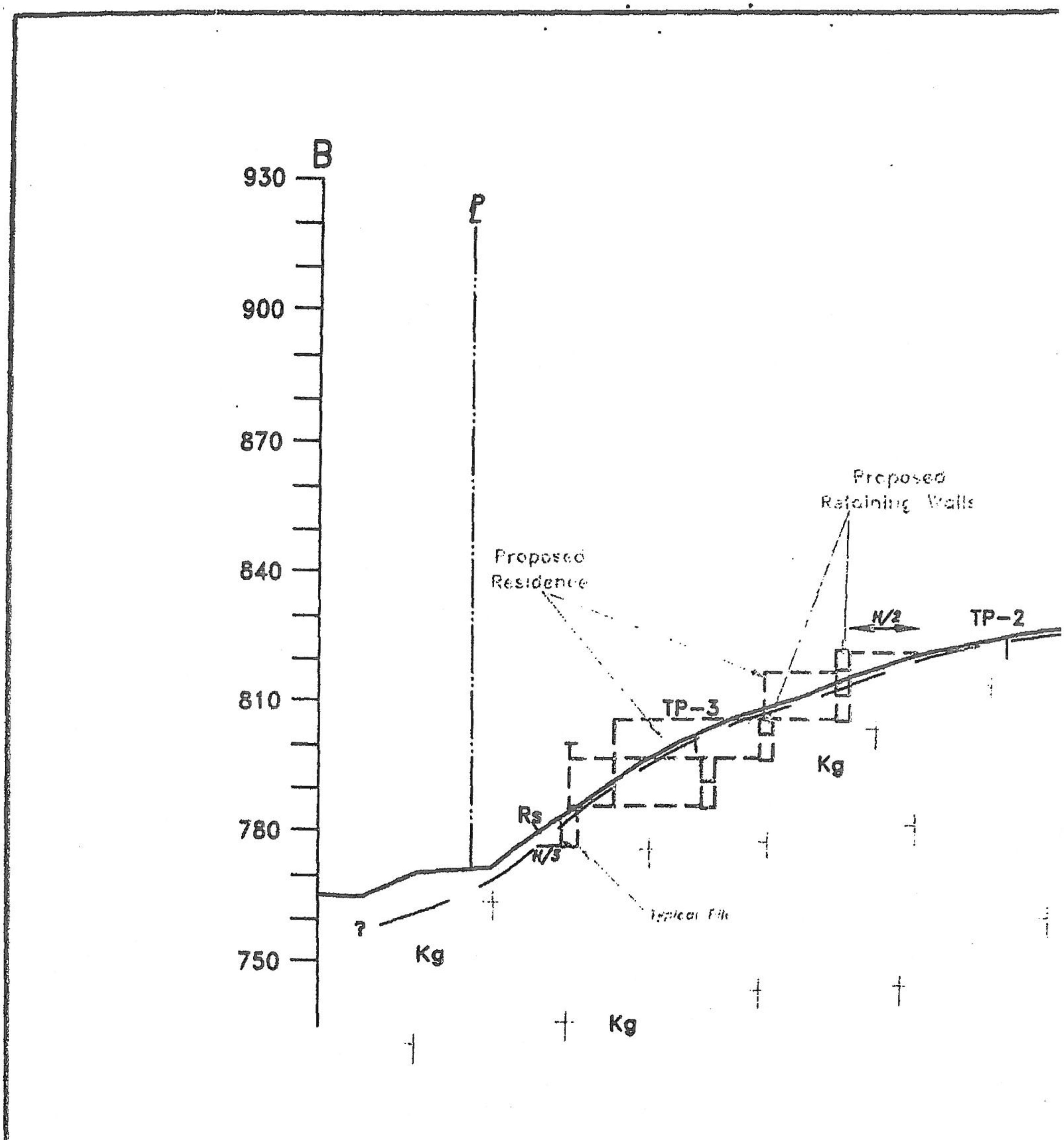


Robles Engineering, Inc.
Geotechnical Consultants

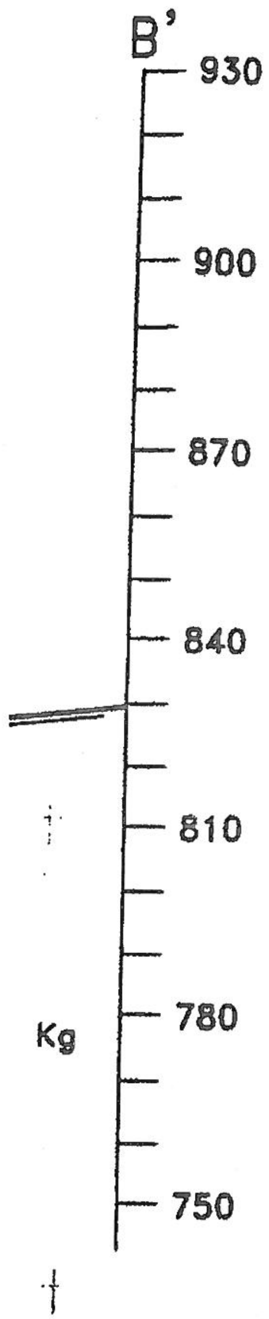
GEOLOGIC CROSS SECTION A-A'

910 Laird Drive
Glendale, California

SCALE: 1"=30'	RE 16-1002	DATE: Nov, 2016	PLATE CS-1



B
930
900
870
840
810
780
750
Proposed
Retaining Walls
Proposed
Residence
TP-3
TP-2
H/2
H/3
Rs
Kg
Kg
Kg
Kg
?



SCALE: 1"=30'

Robles Engineering, Inc.

GEOLOGIC CROSS SECTION B-B'

910 Laird Drive
Glendale, California

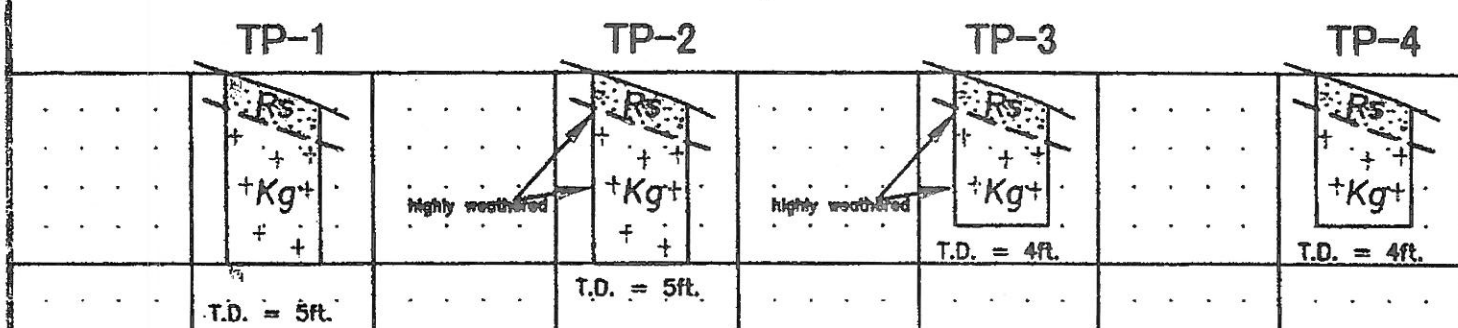
RE 16-1002	DATE: Nov, 2016	PLATE CS-2

TEST PIT LOG NO. TP-1 thru TP-4

LITHOLOGIC DESCRIPTION

(Rs) RESIDUAL SOIL: Silty Sand, brown, dry, loose to medium dense, fine grained, with small bedrock fragments.

(Kg) BEDROCK: Granite, brown to grayish brown, coarsely crystalline, massive, hard, slightly to moderately fractured (tight/random).



- ▯ – Sample Location
- (f) – Strike & Dip of Fracture
- (b) – Strike & Dip of Bedding
- T.D. – Total Depth
- ∇ – Ground Water Elevation

This log of subsurface conditions applies only at the specific location and the date indicated. Subsurface conditions may differ at other locations and times.

SCALE: 1"=5'

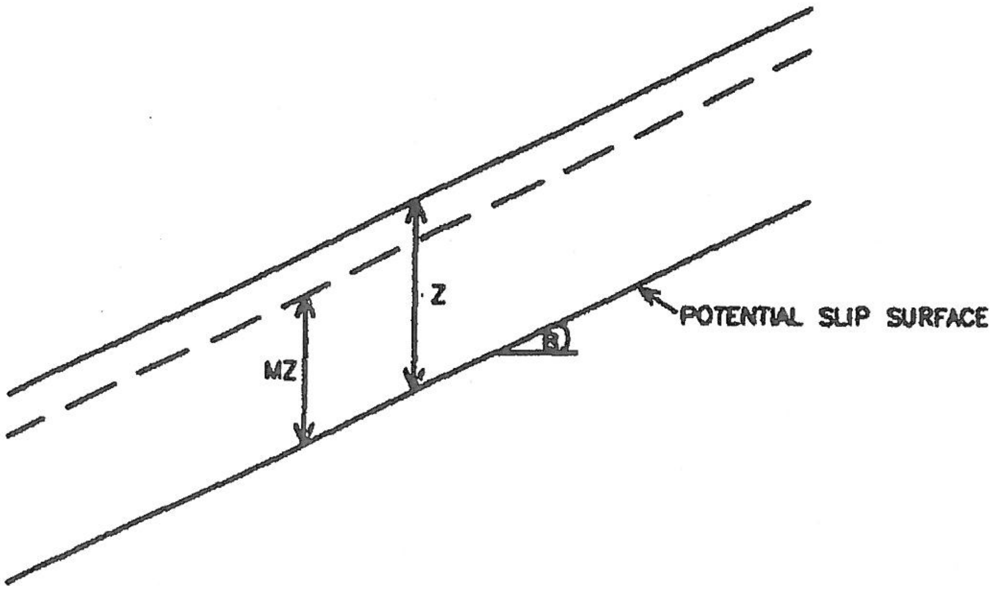
Robles Engineering, Inc.
Geotechnical Consultants

Project: 910 Laird Drive, Glendale California
Date Logged: 11/2/16
Excavation Method: Hand Labor
Logged By: GR
RE No: 16-1002

APPENDIX A-1

(calculations, analyses and details)

SURFICIAL STABILITY



Slope material =	Residual Soil (Rs)	
Dry unit weight of soil, γ_{dry} =	103.4 pcf	
Saturated unit weight of soil, γ_{sat} =	127.5 pcf	
Cohesion of soil, C =	120.0 psf	
Friction angle of soil, ϕ =	29.0 degree	
Slope angle, β =	33.0 degree	(2:1 slope)
Vertical depth of slip surface, Z =	1.0 feet	(maximum 3 feet)
Fraction of the temporary water level to the depth of slip surface, M =	1.0	

FACTOR OF SAFETY :

$$\frac{C+(\gamma_{sat}-M\,\gamma_w)\,Z\cos^2\beta\tan\phi}{\gamma_{sat}\,Z\sin\beta\cos\beta} = 2.50 > 1.5 \quad \text{O.K.}$$

Reference: Campbell (1975). USGS Professional Paper 851.

Robles Engineering, Inc.
Geotechnical Consultants

981 W. ARROW HWY #191 SAN DIMAS, CA 91773
PHONE 818-314-8166 gus@roblesengineering.com

SURFICIAL STABILITY ANALYSIS

910 Laird Drive

Glendale, California

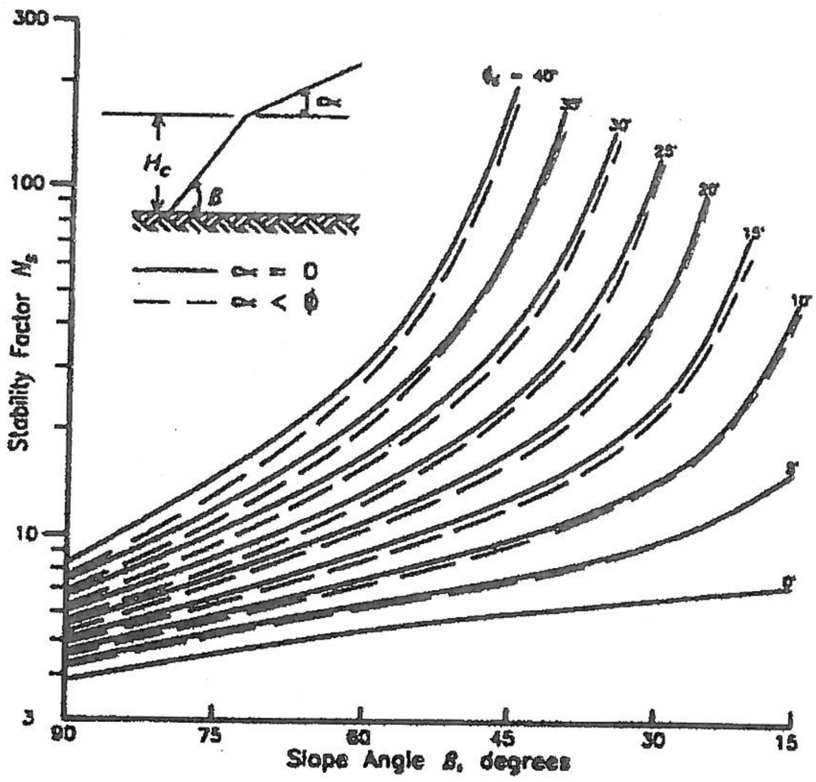
DATE: Nov, 2016	RE 16-1002	PLATE SS-1

GROSS SLOPE STABILITY ANALYSIS

Cohesion of soil (C) = 324.0 psf
Friction angle of soil (ϕ) = 42.0 degree
Unit weight of soil (γ) = 150.6 pcf
Back slope angle (α) = 0.0 degree
Slope angle (β) = 33.0 degree
Factor of Safety = 1.50

Design cohesion (C_d) = *216.0* psf
Design fricition angle (ϕ_d) = *31.0* degree
Stability factor (N_s) = 190.0 (from Chart)
Critical Height (H_c) = $\frac{N_s C_d}{\gamma}$ = *272.5* feet

Bedrock slopes up to 272.5 feet in height have a calculated factor of safety of 1.5
The Bedrock slope has a maximim height of 260-feet, and is considered grossly stable.



Reference: Fang, H.-Y. (1991) Foundation Engineering Handbook, 2nd Ed., Van Nostrand Reinhold, New York, 397-398

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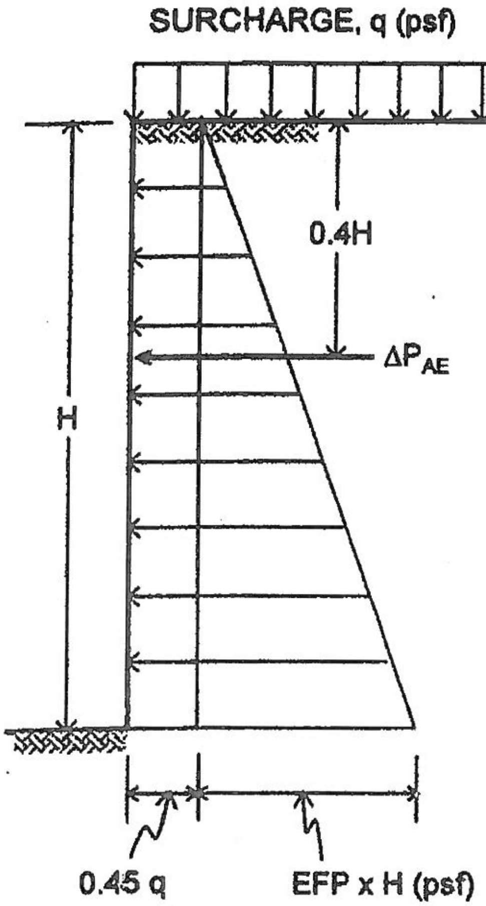
GROSS STABILITY ANALYSIS

910 Laird Drive
Glendale, California

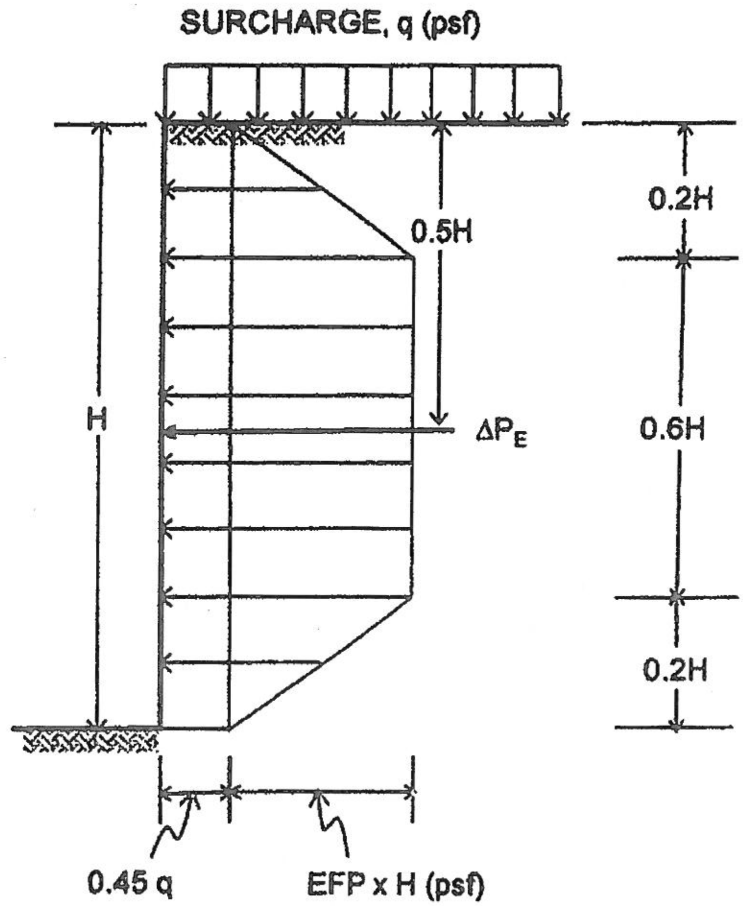
DATE: Nov, 2016	RE 16-1002	PLATE SA-1

EARTH PRESSURE DISTRIBUTION OF RETAINING WALL

Free Standing (Yielding) Wall



Restrained (Non-Yielding) Wall



Seismic Earth Pressure Calculations

γ =	150.6	pcf
PGAm =	1.086	g
PGA = 2/3 (PGAm) =	0.72	g
k_h = PGA/2 =	0.36	(k_h >= 0.15)
$\Delta P_{AE} = 3/8\, k_h \gamma H^2$ =	20.4	H^2 (lb)
$\Delta P_E = k_h \gamma H^2$ =	54.5	H^2 (lb)

Reference: 1. 2014 LABC
2. NEHRP Workshop (2006)

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EARTH PRESSURE DISTRIBUTION
STATIC & SEISMIC LOADS

910 Laird Drive

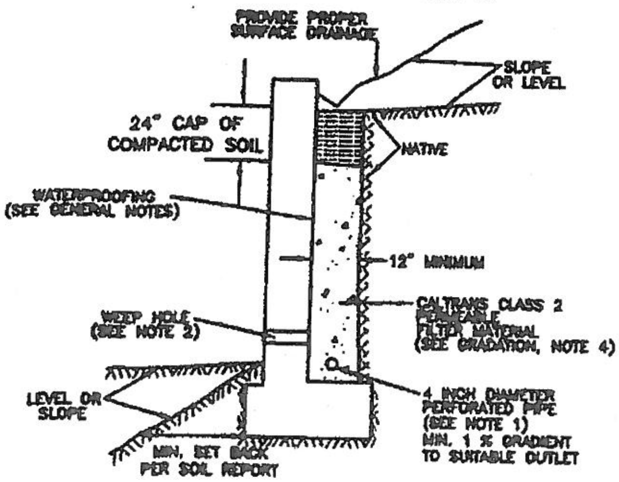
Glendale, California

DATE: Nov, 2016	RE 16-1002	PLATE PD-1

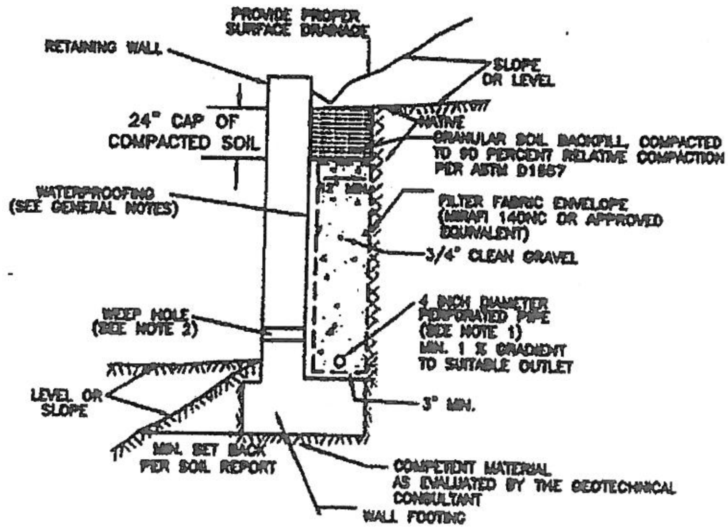
CONFINED BACKFILL AND SUBDRAIN OPTIONS FOR RETAINING WALLS

(Space between back of wall and face of excavation is less than 24-inches)

OPTION 1: PIPE SURROUNDED WITH CLASS 2 PERMEABLE MATERIAL



OPTION 2: GRAVEL WRAPPED IN FILTER FABRIC



GENERAL NOTES:

- *Retaining wall plans should be reviewed and approved by the geotechnical engineer.
- *Walls over 12 feet in height are subject to a special review by the geotechnical engineer and modifications to the above requirements may be necessary (see text of report).
- *Waterproofing should be provided where moisture intrusion through the wall is undesirable.
- *Waterproofing of the walls is not under purview of the geotechnical engineer or geologist.
- *All drains should have a gradient of 1 percent minimum.
- *Outlet portion of the subdrain should have a 4-inch diameter solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding) and must remain clear at all times.
- *Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

NOTES:

1) Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785, Polyvinyl chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down. Perforations should be 3/8 inch in diameter placed at the ends of a 120-degree arc in two rows at 3-inch on center (stagged).

2) Weepholes should be 3-inch minimum diameter and provided at 10-foot maximum intervals. If exposure is permitted, weepholes should be located 12-inches above finished grade. If exposure is not permitted, such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk discharging through the curb face or equivalent should be provided. For a basement-type wall, a proper subdrain outlet system should be provided.

3) All Caltrans Class 2 Permeable Material and gravel backfill should be densified by vibratory compaction.

4) Gradation:

Caltrans Class 2 Filter Permeable Material Gradation
Per Caltrans Specifications

Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

Robles Engineering, Inc.
Geotechnical Consultants

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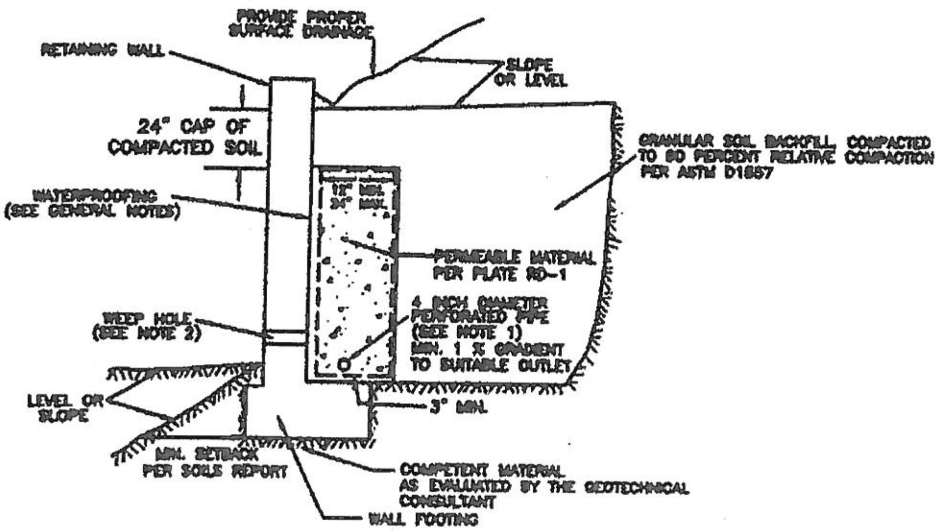
RETAINING WALL BACKFILL AND SUBDRAIN

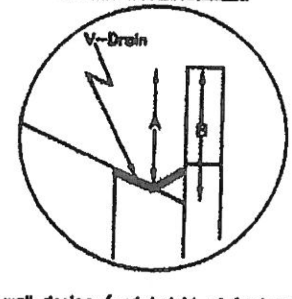
PLATE RD-1

UNCONFINED BACKFILL AND SUBDRAIN OPTIONS FOR RETAINING WALLS

(Space between back of wall and face of excavation is greater than 24–inches)



FREEBOARD DETAIL



* wall design (and height of freeboard) must take into account minimum 2% gradient of v–drain.

* height of freeboard equal to distance "A" (plus thickness of v–drain), not "B".

GENERAL NOTES:

*Retaining wall plans should be reviewed and approved by the geotechnical engineer.

*Walls over 12 feet in height are subject to a special review by the geotechnical engineer and modifications to the above requirements may be necessary (see text of report).

*Waterproofing should be provided where moisture intrusion through the wall is undesirable.

*Waterproofing of the walls is not under purview of the geotechnical engineer or geologist.

*All drains should have a gradient of 1 percent minimum.

*Outlet portion of the subdrain should have a 4–inch diameter solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding) and must remain clear at all times.

*Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

NOTES:

1) Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785. Polyvinyl chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down. Perforations should be 3/8–inch in diameter placed at the ends of a 120–degree arc in two rows at 3–inch on center (staggered).

2) Weepholes should be 3–inch minimum diameter and provided at 10–foot maximum intervals. If exposure is permitted, weepholes should be located 12–inches above finished grade. If exposure is not permitted, such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk discharging through the curb face or equivalent should be provided. For a basement–type wall, a proper subdrain outlet system should be provided.

3) All Caltrans Class 2 Permeable Material and gravel backfill should be densified by vibratory compaction.

Robles Engineering, Inc.
Geotechnical Consultants
[illegible]

RETAINING WALL BACKFILL AND SUBDRAIN

PLATE RD-2

APPENDIX B

(Laboratory Test Results)

EGLAB, INC.,
11819 Goldring Road, Unit D, Arcadia, CA 91006
Ph: 626-263-3588; Fax: 626-263-3599; Email: ryan@eglab.com

November 16, 2016

Robles Engineering, Inc.
981 W. Arrow Hwy. #191
San Dimas, CA 91773

Attn: Mr. Gustavo Robles

RE: **LABORATORY TEST RESULTS/REPORT**
Project Name: 910 Laird Dr, Glendale, CA
Project No.: N/A
EGLAB Job No.: 16-124-024

Dear Mr. Robles:

We have completed the testing program conducted on samples from the above project. The tests were performed in accordance with testing procedures as follows:

TEST	METHOD
Moisture & Dry Density	ASTM D2937
Direct Shear	ASTM D3080

Enclosed is the Summary of Test Results.

We appreciate the opportunity to provide testing services to Robles Engineering, Inc. Should you have any questions, please call the undersigned.

Sincerely yours,
EGLAB, Inc.

Ryan Jones, GE
President

REGISTERED PROFESSIONAL ENGINEER
RYAN KEITH JONES
No. 2852
Exp. 6/30/18
GEOTECHNICAL
STATE OF CALIFORNIA

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NAME: 910 Laird Drive, Glendale

PROJECT NO.: N/A

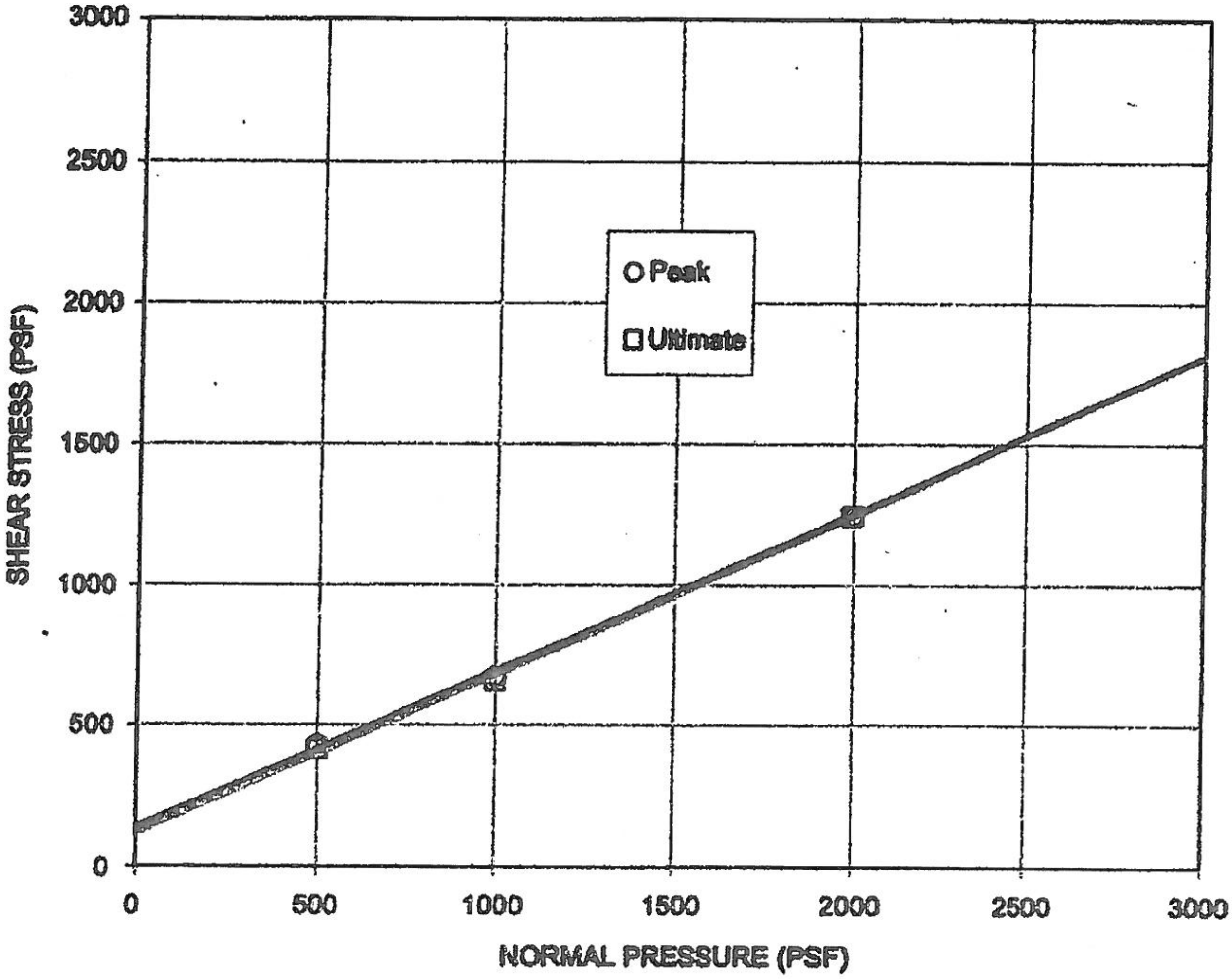
DATE: 11/11/2016

EGLAB JOB NO.: 16-124-024

CLIENT: Robles Engineering, Inc.

SUMMARIZED BY: JT

BORING NO.	SAMPLE NO.	DEPTH (ft)	MOISTURE CONTENT ASTM D2216 (%)	DRY DENSITY ASTM D2937 (PCF)
TP-1	1	0	3.1	99.1
TP-1	2	5.0	2.2	131.7



Boring No.:	Sample No.	Depth (ft)	Sample Type	Soil Type	Symbol	Cohesion (PSF)	Friction Angle
TP-1	1	0	Ring	SC	○	138	29
					□	120	29

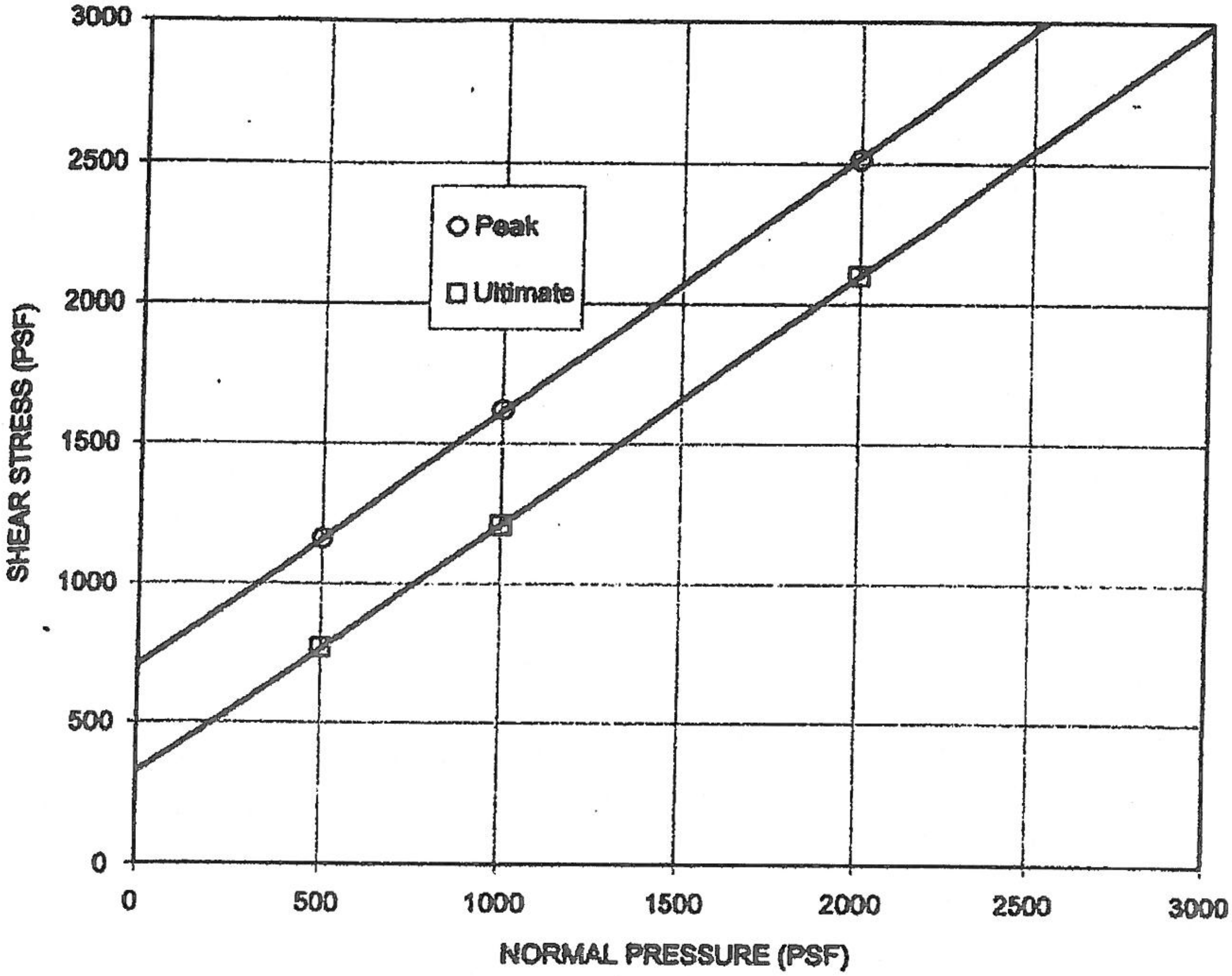
Normal Stress (psf)	Initial Moisture (%)	Final Moisture (%)	γ_d (pcf)	S (%)
500	3.1	23.5	100.0	93
1000	3.1	23.1	100.5	92
2000	3.1	21.0	103.4	90

EGLAB, INC.

Project Name:
910 Laird Drive, Glendale
Client: Robles Engineering, Inc.
Project No: N/A
EGLAB Project No.: 16-124-024

DIRECT SHEAR

11/16 (ASTM D3080) Figure



Boring No.:	Sample No.	Depth (ft)	Sample Type	Soil Type	Symbol	Cohesion (PSF)	Friction Angle
TP-1	2	5	Ring	Bedrock	○	706	42
					□	324	42

Normal Stress (psf)	Initial Moisture (%)	Final Moisture (%)	γ_d (pcf)	S (%)
500	2.2	15.5	129.4	100
1000	2.2	15.2	129.8	100
2000	2.2	15.0	130.4	100

EGLAB, INC.

Project Name:
910 Laird Drive, Glendale
Client: Robles Engineering, Inc.
Project No: N/A
EGLAB Project No.: 16-124-024

DIRECT SHEAR

11/16 (ASTM D3080) Figure