City of South Pasadena
Planning and Community Development Department

Memo

Date: August 25, 2021

To: Chair and Members of the Planning Commission

From: Margaret Lin, Interim Planning and Community Development Director

Prepared By: Malinda Lim, Associate Planner

Re: August 25, 2021 Special Planning Commission Meeting Item No. 1 – Additional Document No. 1 – Revisions to staff report and resolution for 1818 Peterson Avenue (Project No. 2237-HDP/DRX/VAR/TRP)

The preliminary geotechnical report was not included in the staff report. Staff has provided the report here as Attachment 1.

Attachments:

1. Preliminary Geotechnical Report

ATTACHMENT 1

Preliminary Geotechnical Report

Cal Land Engineering, Inc.
dba Quartech Consultants
Geotechnical, Environmental, and Civil Engineering

May 12, 2020

Dr. Kevin W. Chu
c/o Mr. William Chu
1825 Hanscom Drive
South Pasadena, CA 91030

Subject: Report of Geotechnical Engineering Investigation, Proposed Residential Development, 1818 Peterson Avenue, APN: 5308-025-027, South Pasadena, California; QCI Project No.: 15-023-138bEG

Dear Dr. Chu:

In accordance with your request, Quartech Consultants (QCI) has prepared this geotechnical engineering report for the proposed development at the subject site. The purpose of this report was to evaluate the subsurface conditions and to provide recommendations for foundation designs and other relevant parameters for the proposed construction.

Based on the findings and observations during our investigation, it is concluded that the subject site is suitable for its intended use from the geotechnical engineering viewpoint, provided that recommendations set forth herein are followed.

This opportunity to be of service is sincerely appreciated. If you have any questions pertaining to this report, please call the undersigned.

Respectfully submitted,
Cal Land Engineering, Inc. (CLE)
dba Quartech Consultants (QCI)

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REPORT OF GEOLOGIC AND GEOTECHNICAL ENGINEERING INVESTIGATION

Proposed
Residential Development

APN: 5308-025-027
1818 Peterson Avenue
South Pasadena, California

Prepared by

QUARTECH CONSULTANTS (QCI)
Project No.: 15-023-138bGE
May 12, 2020

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1.0 INTRODUCTION

1.1 Purpose

This report presents a summary of our preliminary geotechnical engineering investigation for the proposed residential development at the subject site. The purposes of this investigation were to evaluate the subsurface conditions at the area of proposed construction and to provide recommendations pertinent to grading, foundation design and other relevant parameters.

1.2 Scope of Services

Our scope of services included the followings:

- Review of available soil and geologic data of the subject site and its vicinity.
- Surface mapping and logging/sampling (subsurface exploration) of two hand dug test pits to a maximum depth of 7.5 feet below the existing ground surface. Test pit logs are presented in Appendix A (Field Investigation).
- Laboratory testing of representative samples obtained from the subject site to investigate engineering characteristics of the onsite soils. The laboratory test results are presented in Appendix B (Laboratory Testing) and on the test pit logs (Appendix A).
- Engineering analyses of the geotechnical data obtained from our background studies, field investigation, and laboratory testing.
- Preparation of this report to present our findings, conclusions, and recommendations.

1.3 Proposed Construction

It is our understanding that the lot will be utilized for the construction of a single-family residence. The proposed building is anticipated to be a multi-level wood frame structure. Column loads are unknown to us at this time, but are expected to be light to medium.

1.4 Site Conditions

The subject site is located on the east side of Peterson Avenue, just south of Hill Drive in the City of South Pasadena, California. The approximate regional location is shown on the attached Site Location Map (Figure 1). The site consists of a sloping ground parcel of land, which the slope ratio is approximately ranging from 1.2 to 1 (horizontal to vertical) to 2 to 1 (horizontal to vertical) or flatter. Based on our review of the regional map, it is estimated the total relief of this slope between Peterson Avenue and rear property line is approximately 60 feet. No major erosion was observed during our field investigation. Detail configuration of the site is presented in the attached Site Plan (Figure 2).

1.5 Site History

A geotechnical report was issued for the site by Applied Earth Sciences dated February 26, 2005. Based on this report, it is understood that this report was prepared for the construction of a single-family residence. The planned garage was designed at or near the street level. Shallow foundation and/or caissons founded on competent bedrock was recommended for the support of the planned residence and retaining walls. Surficial slope stability and gross slope stability yielded an adequate factor of safety against sliding. The location of the Test Pits and other geologic data by Applied Earth Sciences is included on the enclosed Figure 2.

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 Field Exploration

Due to the limited access of the site, our subsurface exploration consisted of two hand dug test pits to a maximum depth of 7.5 feet below the existing ground surface. Approximate locations of the test pits are shown on the attached Site Plan (Figure 2). The purpose of the explorations was to assess the engineering characteristics of the onsite soils with respect to the proposed development. An engineering geologist logged the test pits. Relatively undisturbed soil and bulk samples were collected during excavation for laboratory testing. Test pit logs are presented in Appendix A.

2.2 Laboratory Testing

Representative samples were tested for the following parameters: in-situ moisture content and density, direct shear strength, expansion index, Atterberg Limits and corrosion potential. The results of our laboratory testing along with a summary of the testing procedures are presented in Appendix B. In-situ moisture and density test results are provided on the test pit logs (Appendix A).

3.0 GEOLOGIC CONDITIONS

3.1 Site Geology

The earth materials encountered at the subject site include colluvium and bedrock. Description of the subsurface materials from top down is provided as follows:

Colluvium (Qc) - The colluvium consisted of a sandy clay to clayey silt layer, grayish to medium brown, slightly moist. The depth of the existing colluvium where encountered is approximate 5 feet. The encountered colluvium was loose, porous and slightly rooted and not suitable for structural supports.

Monterey Formation (Tmsl)

Based on our review of the regional geological map and field investigation, below the colluvium is the bedrock of the Monterey Formation. Bedrock consisted of sandstone, yellowish brown in color with gray siltstone interbeds. The encountered bedrock was slightly moist, moderately hard and fractured. Bedding is relatively uniform oriented, striking west and dips northerly between 50 to 65 degrees.

3.2 Geologic Structures

Based on our review the referenced reports and our subsurface exploration, bedrock generally dips toward northwest at moderate to high angles. Bedding plane orientation generally appears neutral to unfavorable with respect to the overall site stability.

3.3 Ground Water

Static ground water levels were not encountered during our subsurface investigation. Groundwater is therefore not expected to be a significant constraint during the construction.

4.0 SEISMICITY

4.1 Estimated Earthquake Ground Motions

In order to estimate the seismic ground motions at the subject site, QCI has utilized the seismic hazard map published by California Geological Survey. According to this report, the peak ground alluvium acceleration at the subject site for a 2% and 10% probability of exceedance in 50 years is about 0.956g and 0.563g, respectively (2008 USGS Interactive Deaggregation). Site modified peak ground acceleration (PGA_M), corresponding to USGS Design Map Summary Report, ASCE 7-16 Standard is 1.100g.

4.2 Faulting

Based on our study, there are no known active faults crossing the property. The nearest known regional fault is the Raymond Fault is located approximately 1.1 miles from the site.

4.3 Seismicity

The subject site is located in southern California, which is a tectonically active area. The type and magnitude of seismic hazards affecting the site depend on the distance to causative faults, the intensity, and the magnitude of the seismic event. Table 1 indicates the distance of the fault zones and the associated maximum magnitude earthquake that can be produced by nearby seismic events. As indicated in Table 1, the Raymond fault is considered to have the most significant effect to the site from a design standpoint.

TABLE 1

Characteristics and Estimated Earthquakes for Regional Faults

Fault Name	Approximate Distance To The Site	Maximum Magnitude Earthquake (Mmax)
Raymond	1.1	6.8
Verdugo	2.2	6.9
Elysian Park (Upper)	2.8	6.7
Hollywood	3.4	6.7
Santa Monica Conn alt 2	6.4	7.4
Sierra Madre Connected	7.0	7.3
Sierra Madre	7.0	7.2
Puente Hills (LA)	9.2	7.0
Elsinoe;W	10.4	7.0
Clamshell-Sawpit	11.2	6.7
Newport Inglewood Conn alt 2	12.9	7.5
Newport-Inglewood, alt 1	13.0	7.2
Newport Inglewood Conn alt 1	13.0	7.5
Puente Hills (Santa Fe Springs)	13.7	6.7
Santa Monica Connected alt 1	13.9	7.3
Santa Monica, alt 1	13.9	6.6
Sierra Madre (San Fernando)	13.9	6.7
San Gabriel	16.0	7.3
Puente Hills (Coyote Hills)	16.3	6.9
San Jose	17.5	6.7
Northridge	18.4	6.9

Reference: 2008 National Seismic Hazard Maps - Source Parameters

5.0 SLOPE STABILITY

5.1 General

The site consists of a sloping ground parcel of land which the slope ratio is approximately ranging from 1.2 to 1 (horizontal to vertical) and 2 to 1 (horizontal to vertical) or flatter. From the street to approximately 20 feet into the property there is an ascending cut slope of approximately 1.2 to 1 (horizontal to vertical). From the end of the cut slope to the easterly property line a gentle 2 to 1 (horizontal to vertical) ascending slope for a distance of 40 feet. Total relief is approximately 40 feet. No evidence of major surficial erosions was observed during our field investigation.

Both surficial slope stability and gross slope stability of the existing slope is analyzed and the computer print-out is presented in Appendix C. Shear strength of the bedrock is selected based on our laboratory testing results.

Based on our analyses, it is recommended that 2 row of stabilization caissons should be constructed at the rear portion of the proposed retaining walls as indicated at the attached Site Plan, Figure 2. The caissons may be spacing at the distance of 6 feet for 2-foot diameter caisson and 9 feet for 3-foot diameter caisson. The recommended minimum depth of the caissons and lateral loads are presented in the following table.

TABLE 2

Caisson Recommendations

Row	Depth Below Calculated Slip Plane (feet)	Recommended Lateral Loads per 2' Diameter Caissons (lbs)
1	21	120,000
2	6	120,000

The approximate locations of Row 1 and Row 2 are indicated in the attached Site Plan, Figure 2. Resistance to the above recommended lateral loads may be provided by the friction acting at the base of the caissons and by the passive earth pressure for the portion of the caissons embedded below the above calculated slip plane. The required embedment depth may be designed by the project structural engineer.

5.2 Surficial Slope Stability and Landscaping

Slopes should be protected from surface runoff by means of top-of-slope compacted earth berms or concrete interceptor drains. All slopes should be landscaped with a suitable plant material requiring minimal cultivation and irrigation water in order to thrive. An irrigation system should be installed. Overwatering and subsequent saturation of slope surfaces should be avoided.

At all times avoid saturation or desiccation of the slope materials since these conditions tend to deteriorate the slope. Irrigation facilities should be turned off during the rainy season. Maintenance includes correction of defective drainage terraces on slope, elimination of burrowing rodents, corrections of defective irrigation facilities, and controlled slope vegetation growth. Irrigation programs for all landscaped slopes should be well controlled and minimized. Seasonal adjustments should be made to prevent excess moisture in the slope soils. Overwatering, especially prior to winter storms, may generate surficial slope distress.

6.0 CONCLUSIONS

Based on the results of our subsurface investigation and reference reports, it is our opinion that the proposed construction is feasible from a geotechnical standpoint, provided the recommendations contained herein are incorporated in the design and construction. The following is a summary of the geotechnical design and construction factors that may affect the development of the site.

6.1 Seismicity

Based on our studies on seismicity, there are no known active faults crossing the property. However, the site is located in a seismically active region and is subject to seismically induced ground shaking from nearby and distant faults, which is a characteristic of all Southern California.

6.2 Seismic Induced Hazards

Based on our review of the "Seismic Hazard Zones, Los Angeles Quadrangle" by CGS (formerly CDMG), it is concluded that the site is located in the mapped potential seismic induced landslide areas.

6.3 Excavatability

Based on our subsurface investigation, excavation of the subsurface materials should be accomplished with conventional earthwork equipment.

6.4 Surficial Soil Conditions

Based on our review of the referenced reports and recent site investigation, it is understood that the site has surficial colluvium soils. Considering that the proposed construction will be located within the existing ascending slope area, the existing slope should be properly maintained. All surface water should be directed via approved drainage devices. Concentrated flows or un-control flow should be avoided within the site and slopes.

6.5 Groundwater

Groundwater was not encountered during our field exploration. Groundwater is therefore not expected to be a significant constraint during the construction.

7.0 RECOMMENDATIONS

Based on the subsurface conditions exposed during field investigation and referenced report, it is recommended that the following recommendations be incorporated in the design and construction phases of the project.

7.1 Grading

<u>7.1.1 Site Preparation</u>

Prior to initiating grading operations, any existing vegetation, trash, debris, over-sized materials (greater than 8 inches), and other deleterious materials within fill areas should be removed.

<u>7.1.2 Excavation/Surficial Soil Removals</u>

Within grading limits, existing surficial soils should be removed to expose competent bedrock. All excavations should be observed by a representative of this office to verify the subgrade soil conditions and determine if additional removals or other mitigative measures are needed.

Should the bedrock materials with differing expansion characteristics are exposed within the building pads, the building pad(s) subgrade require overexcavation and replacement with compacted fill to a minimum depth of 4 feet below the pad grade to provide a uniform consistency and thickness of soils for foundation support. Outside the building areas, the colluvium is loose and weathered and should be removed to expose competent bedrock.

<u>7.1.3 Treatment of Removal Bottoms</u>

Soils exposed within areas approved for fill placement should be scarified to a depth of 6 inches, conditioned to near optimum moisture content, then compacted in-place to 90 percent relative compaction based on laboratory standard ASTM D-1557-12.

7.2 Temporary Excavation

The required construction for the proposed lower level pad will extend to a maximum of approximately 6~20 feet below the existing ground surface. The criteria for the temporary excavation depends on many factors, which include depth of excavation, soil conditions, distance to the existing structures or public improvement, consequences of potential ground movement, and construction procedures.

7.2.1 Sloping Excavation

Should the space be available at the site, the required excavation may be made with sloping banks. Based on materials encountered in the test borings, it is our opinion that sloped excavations may be made no steeper than 1:1 (horizontal to vertical) for the underlying native soils. Flatter slope cuts may be required if loose soils encountered during excavation. No heavy construction vehicles, equipment, nor surcharge loading should be permitted at the top of the slope. A representative of this office should inspect the temporary excavation to make any necessary modifications or recommendations.

7.2.2 Shoring

Shoring will be required for temporary excavation made vertically or near vertically. An active earth pressure of 30 pounds per cubic foot may be used for the temporary cantilever shoring system. Any surcharged loads resulting from the adjacent building or the traffic in the adjacent street or alley should be considered as an added loads to the above recommended. Soldier piles or beams should be spaced at the required distance specified by the project structural/shoring engineer. Lagging may be required to span between soldier piles to support the lateral earth pressure. Concrete and/or lean-mix slurry may be used for the temporary shoring soldier piles. The use of the slurry should have sufficient strength to resist the lateral pressures as recommended in this report.

The shoring and bracing should be designed and constructed in accordance with current requirements of CAL/OSHA and all other public agencies having jurisdiction. Careful examination of the soil excavation and inspection of on-site installation of the shoring system by a representative of this office is recommended to verify the conditions or to make recommendations as are pertinent if different conditions are disclosed during excavation.

7.3 Foundation Design

Both conventional shallow foundation and caissons may be used for the proposed residential foundation support. The following presented the foundation design recommendations:

7.3.1 Shallow Foundation

An allowable bearing value of 5000 pounds per square foot (psf) may be used for design of continuous and pad footings with a minimum of 12 and 24 inches in width, respectively. All footings should be a minimum of 24 inches deep and founded at least 18 inches into the competent bedrock, whichever is deeper. This value may be increased by one third (1/3) when considering short duration seismic or wind loads.

7.3.2 Caisson Foundation

In order to increase the factor of safety of the proposed slope, stabilization caissons should be constructed at the rear portion of the planned development. The approximately locations of the recommended stabilization caissons are indicated in the attached Site Plan, Figure 2. The caissons should be a minimum of 10 feet into competent bedrock. Caissons may be designed for an allowable end bearing of 5000 psf. Caisson may be assumed fixed at 2 feet into bedrock. Caissons should be at least 24 inches in diameter to facilitate cleanout. The base of all caissons excavations should be cleaned of all loose materials. All caissons should be tied in two horizontal directions with grade beams or footings.

For caissons spacing greater than 3 times of the caisson diameter can be considered as isolated caissons and the passive earth pressure can be increased by 100 percent.

7.3.3 Settlement

Settlement of the footings placed as recommended and subject to no more than allowable loads is not anticipated to exceed 3/4 inch. Differential settlement between adjacent columns is not anticipated to exceed 1/2 inch.

7.3.4 Lateral Pressures

The active earth pressure to be utilized for cantilever retaining wall designs may be computed as an equivalent fluid having a density of 40 pounds per cubic foot when the slope of the backfill behind the wall is level. The at-rest earth pressure to be utilized for restrained retaining wall designs may be computed as an equivalent fluid having a density of 70 pounds per cubic foot.

Earthquake earth pressure distribution on retaining walls retaining more than 6 feet of soils when the slope of the backfill behind the wall is level may be computed as an inverted right triangle with 33H psf at the base. Resultant seismic earth force may be applied at approximately 0.6xH from the top of the footing. H should be measured from top of footing to the top of wall. The earthquake-induced pressure should be added to the static earth pressure. Design of walls less than 6 feet in height may neglect the additional seismic pressure.

Resistance to the lateral loads may be provided by the passive earth pressure within the bedrock and by friction acting at the base of the foundation and bedrock. Passive earth pressure may be computed as an equivalent fluid pressure of 290 psf, with a maximum earth pressure of 5000 psf. An allowable coefficient of friction between soil and concrete of 0.30 may be used with the dead load forces. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one third (1/3).

7.4 Foundation Construction

It is anticipated that the entire structure will be underlain by onsite soils of medium expansion potential (EI=72). In accordance with Section 1808.6.4 of the 2019 California Building Code the soil should be stabilized by presaturation and all footings and slabs should be constructed as follows:

All footings should be founded at a minimum depth of 24 inches below the lowest adjacent ground surface and founded at least 18 inches into the completent bedrock, whichever is deeper. All continuous footings should have at least two No. 4 reinforcing bars placed within four inches of the top of the footing and two No. 4 bars shall be placed between 3 inches and 4 inches of the bottom of the footing. Foundations for exterior walls and interior bearing walls shall be tied to the floor slabs by reinforcing bars (dowels) having a diameter of not less than ½ inch (No. 4 bar) reinforcing bars and spaced at intervals not exceeding 16 inches on center. The reinforcing bars extend at least 40 bar diameters into the footings and the slabs.

Presaturation of soils is recommended for concrete slab areas. The moisture condition of each slab area should be 120 percent or greater of optimum moisture content to a depth of 24 inches below slab grade prior to pouring of slabs. Presaturation may be facilitated by maintaining the water content prior to foundation construction by periodic spraying and by slowly adding additional water after foundations are in.

7.5 Concrete Flatwork

Concrete slab for flatwork areas should be a minimum of 5 inches thick and reinforced with a minimum of No. 4 bars at 16-inches in center both ways or equivalent. All slab reinforcement should be supported to ensure proper positioning during placement of concrete.

In order to comply with the requirements of the 2019 CalGreen Section 4.505.2.1 within the moisture sensitive concrete slabs, a minimum of 4-inch thick base of ½ inches or larger clean aggregate should be provided with a vapor barrier in direct contact with concrete. A 10-mil Polyethylene vapor retarder, with joints lapped not less than 6 inches, should be placed above the aggregate and in direct contact with the concrete slabs. As an alternate method, 3 inch of sand then 10-mil polyethylene membrane and another 3 inches of sand over the membrane and under the concrete may be used, provided this request for an alternative method is approved by City Building Officials.

7.6 Retaining Wall Backfill and Drainage

Walls may be backfilled with onsite materials. A free drainage, select backfill (SE of 30 or grater), should be used against the retaining wall. The upper 18 inches of backfill should consist of native soils. All backfill should be compacted to at least 90 percent minimum relative compaction of 90 percent of ASTM D-1557-12.

Any proposed retaining walls retaining more than 2 feet of soils should be provided with backdrains to reduce the potential for the buildup of hydrostatic pressure. Backdrains should consist of 4-inch (minimum) diameter perforated PVC pipe surrounded by a minimum of 1 cubic foot per lineal foot of clean coarse gravel wrapped in filter fabric (Mirafi 140 or the equivalent) placed at the base of the wall. The drain should be covered by no less than 18 inches (vertical) of compacted wall backfill soils. The backdrain should outlet through non-perforated PVC pipe or weepholes. Alternatively, commercially available drainage fabric (i.e., J-drain) could be used. The fabric manufacturer's recommendations should be followed in the installation of the drainage fabric backdrain.

If there is not enough room for placing the above mentioned drainage systems, an alternative system such as pre-fabricated drainage system AQUADRAIN 100 BD with a 3-inch drain pipe set in gravel behind the wall, to prevent the buildup of hydrostatic pressure. This drainpipe may be connected to a 3-inch drain collector pipe connected to approve drainage system

7.7 Temporary Excavation and Backfill

All trench excavations should conform to CAL-OSHA and local safety codes. All utilities trench backfill should be brought to near optimum moisture content and then compacted to obtain a minimum relative compaction of 90 percent of ASTM D-1557-12. All temporary excavations should be observed by a field engineer of this office so as to evaluate the suitability of the excavation to the exposed soil conditions.

8.0 INSPECTION

As a necessary requisite to the use of this report, the following inspection is recommended:

- Temporary excavations.
- Removal of surficial and unsuitable soils.
- Backfill placement and compaction.
- Utility trench backfill.

The geotechnical engineer should be notified at least 1 day in advance of the start of construction. A joint meeting between the client, the contractor, and the geotechnical engineer is recommended prior to the start of construction to discuss specific procedures and scheduling.

9.0 CORROSION POTENTIAL

Chemical laboratory tests were conducted on the existing onsite near surface materials sampled during QCI's field investigation to aid in evaluation of soil corrosion potential and the attack on concrete by sulfate soils. The testing results are presented in Appendix B.

According to 2019 CBC and ACI 318-16, a "negligible" exposure to sulfate can be expected for concrete placed in contact with the onsite soils. Therefore, Type II cement or its equivalent may be used for this project. Based on the resistivity test results, it is estimated that the subsurface soils are corrosive to buried metal pipe. It is recommended that any underground steel utilities be blasted and given protective coating. Should additional protective measures be warranted, a corrosion specialist should be consulted.

9.0 SEISMIC DESIGN

Based on our studies on seismicity, there are no known active faults crossing the property. However, the subject site is located in Southern California, which is a tectonically active area.

Based on the ASCE 7-16 Standard, CBC 2019, the following seismic related values may be used:

Seismic Parameters (Latitude: 34.103813, Longitude: -118.173981)	Site Class "C"
Mapped 0.2 Sec Period Spectral Acceleration, S_s	2.108g
Mapped 1.0 Sec Period Spectral Acceleration, S_1	0.724g
Site Coefficient for Site Class "D", F_a	1.2
Site Coefficient for Site Class "D", F_v	1.4
Maximum Considered Earthquake Spectral Response Acceleration Parameter at 0.2 Second, S_{MS}	2.530g
Maximum Considered Earthquake Spectral Response Acceleration Parameter at 1.0 Second, S_{M1}	1.014g
Design Spectral Response Acceleration Parameters for 0.2 sec, S_{DS}	1.686g
Design Spectral Response Acceleration Parameters for 1.0 Sec, S_{D1}	0.676g

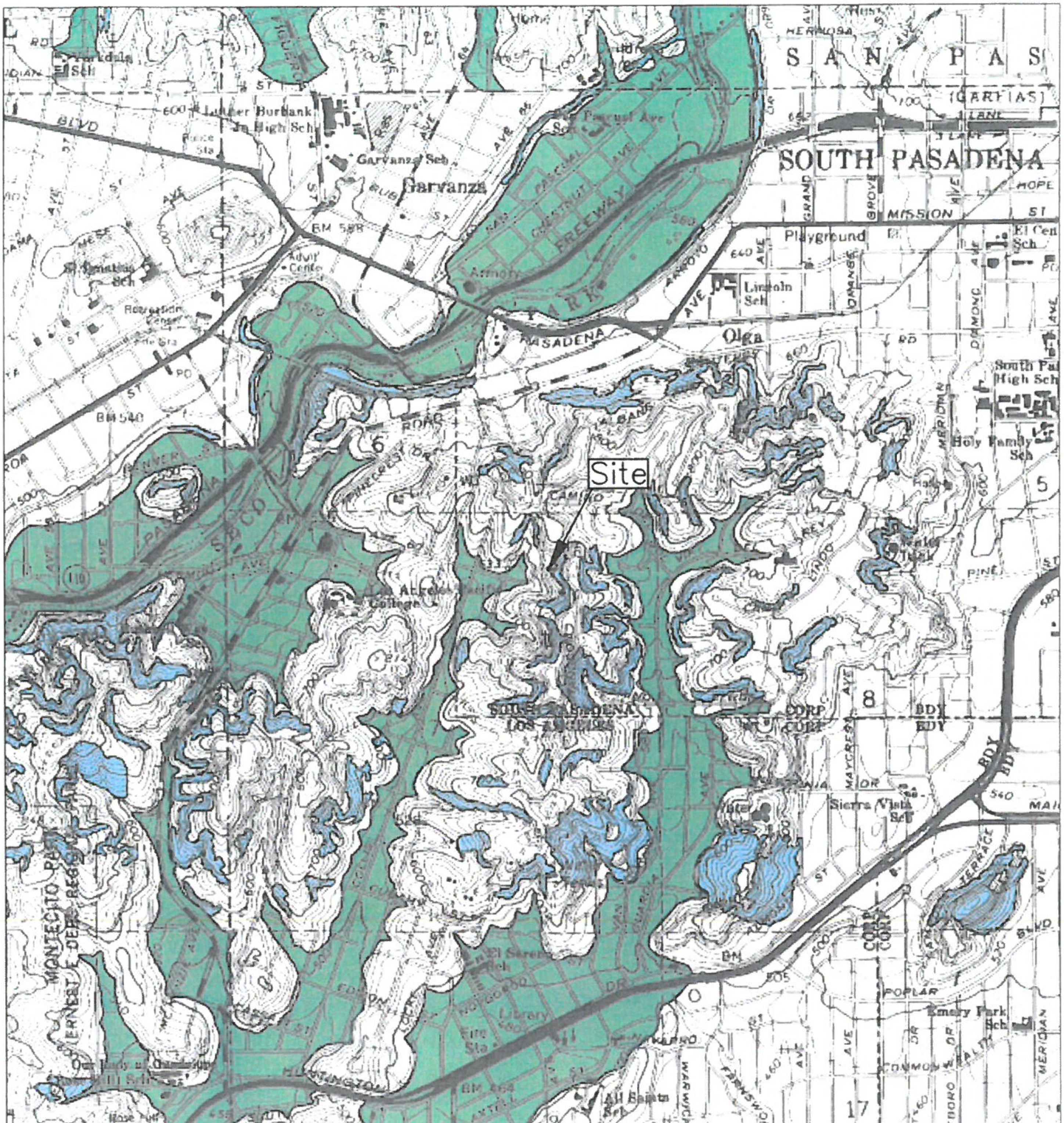
The Project Structural Engineer should be aware of the information provided above to determine if any additional structural strengthening is warranted.

11.0 REMARKS

The conclusions and recommendations contained herein are based on the findings and observations at the exploratory locations. However, soil materials may vary in characteristics between locations of the exploratory locations. If conditions are encountered during construction, which appear to be different from those disclosed by the exploratory work, this office should be notified so as to recommend the need for modifications. This report has been prepared in accordance with generally accepted professional engineering principles and practice. No warranty is expressed or implied.

12.0 REFERENCE

"Report of Geotechnical Investigation, Proposed Single Family Residence, Lot 5 of Tract No. 2672, 1818 Peterson Drive, South Pasadena. California" by Applied Earth Sciences. Project No. 04-483-02, dated February 26, 2005.



SCALE 1" = 2000'

LEGEND

Maps modified from "Seismic Hazard Zones, Los Angeles Quadrangle" by CDMG

CalLand Engineering, Inc.
dba Quartech Consultants

Geotechnical, Environmental & Civil Engineering Services

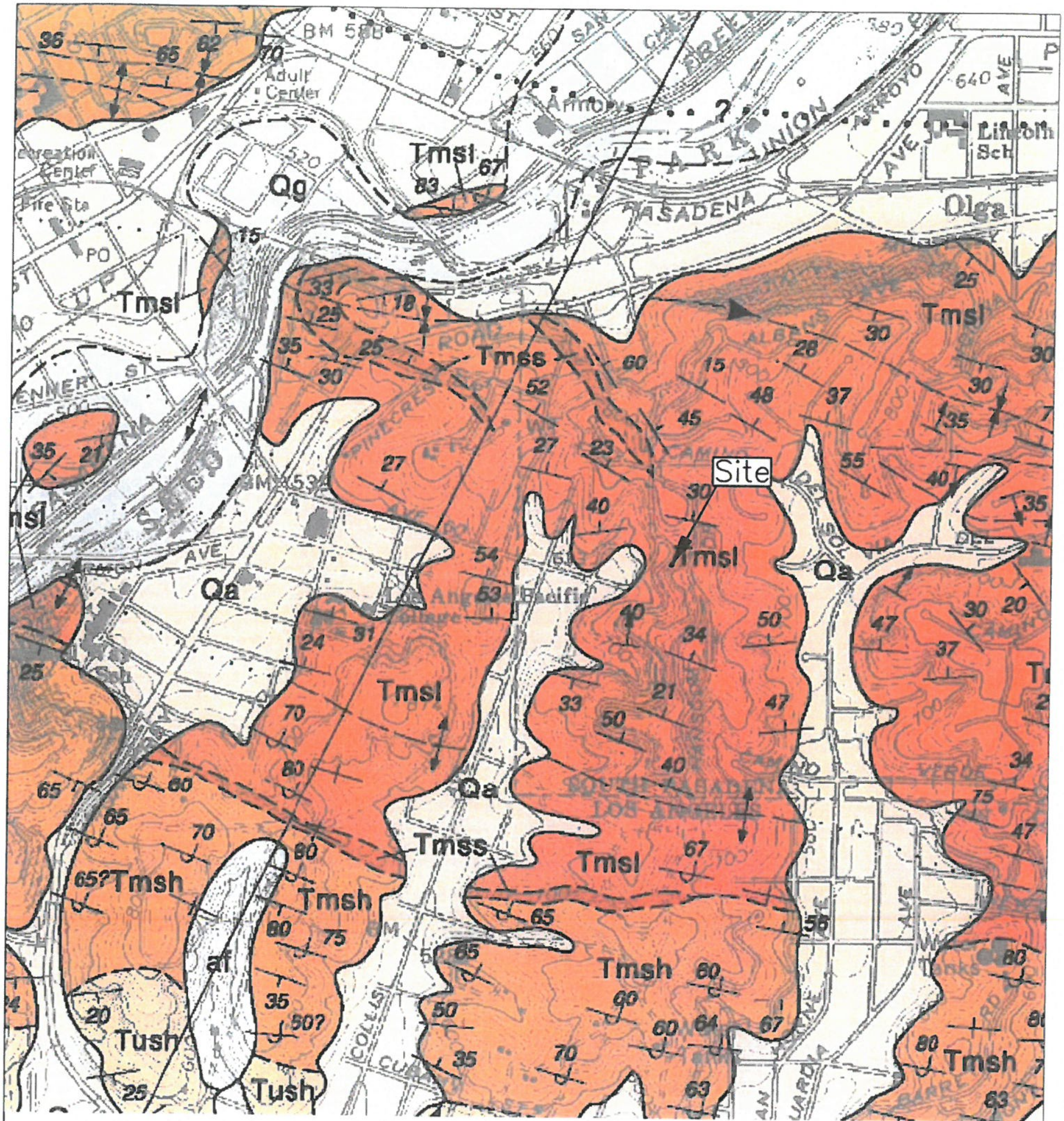
Project Address:

APN: 5308-025-027
1818 Peterson Avenue
South Pasadena, California

Site Location Map

12/19

FIGURE 1



N

NOT TO SCALE

LEGEND

Maps modified from "Geological Map of the Los Angeles Quadrangles"
Los Angeles County, CA
by Thomas W. Dibblee, Jr., 2001

Monterey Formation
Tmsl – Gray, micaceous silty shale and silstone; includes some semi-siliceous to siliceous shale and thin sandstone beds; Mohnian and Luisian Stages (includes upper part of Topanga Formation of Lamar, 1970)

CalLand Engineering, Inc. dba Quartech Consultants Geotechnical, Environmental & Civil Engineering Services	Project Address: APN: 5308-025-027 1818 Peterson Avenue South Pasadena, California

Regional Geologic Map

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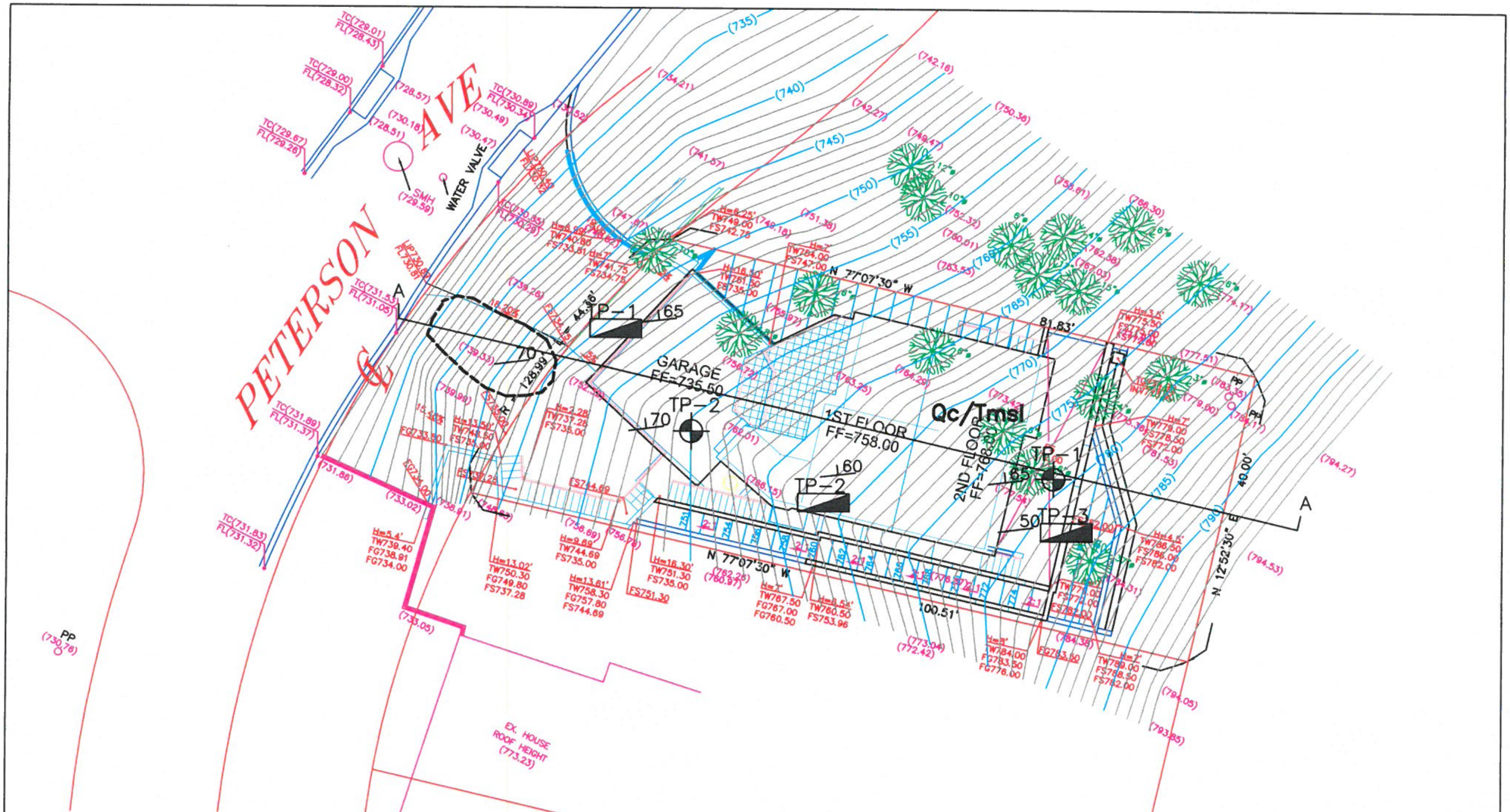
FIGURE 1a



LEGEND

Tmsl	Monterey Formation
Qc	Colluvium
TP-1 (boring symbol)	Approximate boring location by Cal Land Engineering
TP-1 (test pit symbol)	Approximate test pit location by Applied Earth Science
(dashed outline)	Bedrock Outcrop
70	Bedding, Attitude
A A	Cross Section

N

SCALE: 1" = 20'

CalLand Engineering, Inc.
dba Quartech Consultants

Geotechnical, Environmental & Civil Engineering Services

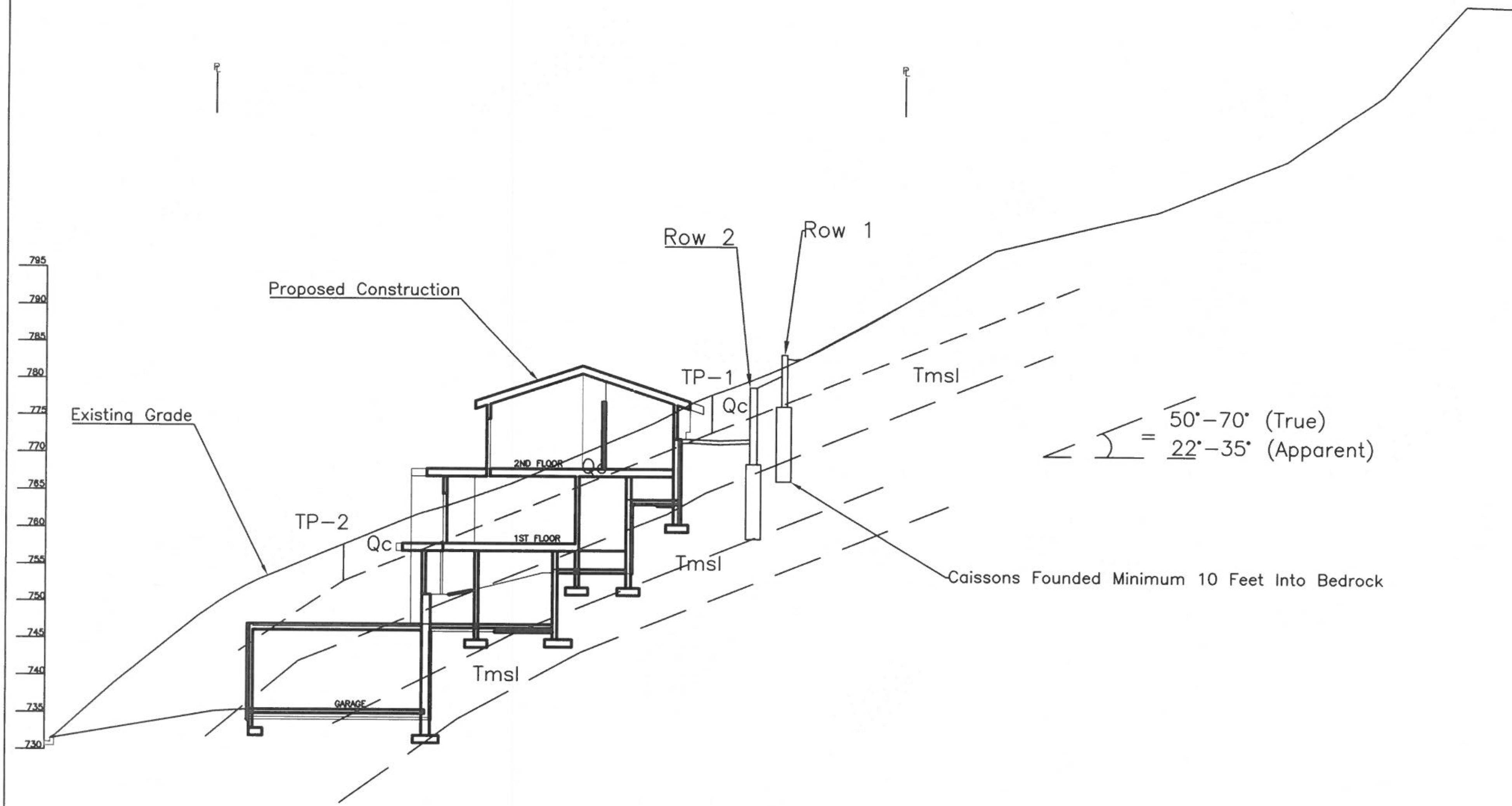
Project Address:

APN: 5308-025-027
1818 Peterson Avenue
Los Angeles, California

SITE PLAN

4/20

FIGURE 2



SCALE: 1" = 20'

CalLand Engineering, Inc. dba Quartech Consultants Geotechnical, Environmental & Civil Engineering Services	Project Address: APN: 5308-025-027 1818 Peterson Avenue South Pasadena, California

Cross Section A-A

4/20

FIGURE 2

APPENDIX A
FIELD INVESTIGATION

Subsurface conditions were explored by excavating two hand dug test pits to a maximum depth of 11.0 feet at approximate locations shown on the enclosed Site Plan (Figure 2). Upon completion of excavation, the test pits were backfilled with onsite soils that were removed from the excavations.

The excavation of the test pits was supervised by an engineering geologist, who continuously logged the test pits and visually classified the soils in accordance with the Unified Soil Classification System. Ring samples were taken at frequent intervals.

CalLand Engineering, Inc
dba Quartech Cosultants

TEST PIT LOG TP-1

PROJECT LOCATION: 1818 Peterson Avenue, South Pasadena. CA
PROJECT NO.: 15-023-138

DATE DRILLED: 11/13/2019
SAMPLE METHOD: Hand Dug Pits
ELEVATION: N/A
LOGGED BY: FA

B: Bulk Bag
S: Standard Penetration Test
R: Ring Sample

Depth (ft)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/12"	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Description of Material
							Colluvium (Qc) at 0-5':
2				ML			Clayey silt, medium brown, moist, firm, porous, slightly rooted, few rock fragments
		R		ML	81.1	19.3	@ 3', moist, firm to stiff Percent of Fines: 78.9
5							
							Bedrock (Tmsl) at 5':
		R		BR	90.1	18.1	Sandstone, yellowish brown, gray siltsotne interbeds, moist, moderatly hard, fractured (B) N 85 E, 65 NW
10							
							Total Depth: 6.5 feet No Groundwater Hole Backfilled
15							
20							
25							
30							
35							

CalLand Engineering, Inc
dba Quartech Cosultants

TEST PIT LOG TP-2

PROJECT LOCATION: 1818 Peterson Avenue, South Pasadena. CA
PROJECT NO.: 15-023-138

DATE DRILLED: 11/13/2019
SAMPLE METHOD: Hand Dug Pits
ELEVATION: N/A
LOGGED BY: FA

B: Bulk Bag
S: Standard Penetration Test
R: Ring Sample

Depth (ft)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/12"	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Description of Material
	B			CL		19.1	Colluvium (Qc) at 0-5': Sandy clay, fine grained,gray-brown, moist, porous, slightly rooted, firm
2				CL			@ 3', Sandy clay, medium brown, moist, firm to stiff Percent of Fines: 76.9, LL= 43, PL= 24, PI= 19
5		R		BR	88.2	18.5	Bedrock (Tmsl) at 5': Sandstone, yellowish brown, gray siltsotne interbeds, moist, moderatly hard, fractured (B) N65E, 70NW
10							Total Depth: 7.5 feet No Groundwater Hole Backfilled
15							
20							
25							
30							
35							

APPENDIX B
LABORATORY TESTING

During the subsurface exploration, QCI personnel collected relatively undisturbed ring samples and bulk samples. The following tests were performed on selected soil samples:

Moisture-Density

The moisture content and dry unit weight were determined for each relatively undisturbed soil sample obtained in the test borings in accordance with ASTM D2937 standard. The results of these tests are shown on the boring logs in Appendix A.

Shear Tests

Shear tests were performed in a direct shear machine of strain-control type in accordance with ASTM D3080 standard. The rates of deformation were 0.010 inch per minute. Selected samples were sheared under varying confining loads in order to determine the Coulomb shear strength parameters: internal friction angle and cohesion. The shear test results are presented in the attached Figures.

Consolidation Tests

Expansion Index

Expansion Index test was conducted on the existing onsite near surface materials sampled during QCI's field investigation. The test is performed in accordance with ASTM D-4829. The testing results are presented below:

Sample Location	Expansion Index	Expansion Potential
TP-2 @ 0-5'	72	Medium

Corrosion Potential

Chemical laboratory tests were conducted on the existing onsite near surface materials sampled during QCI's field investigation to aid in evaluation of soil corrosion potential and the attack on concrete by sulfate soils. These tests are performed in accordance with California Test Method 417, 422, 532, and 643. The testing results are presented below:

Sample Location	pH	CT-412 Chloride (ppm)	CT-417 Sulfate (% by weight)	CT-532 Min. Resistivity (ohm-cm)
TP-2 @ 0-5'	9.34	197	0.0020	1,500

Atterberg Limits

Laboratory Atterberg Limits tests were conducted on the existing onsite materials sampled during QCI's field investigation to aid in evaluation of soil liquefaction potential. These tests are performed in accordance with ASTM D4318. The testing results are presented below:

Sample Location	USCS Class. ASTM D2488	Liquid Limit %ASTM D4318	Plastic Limit %ASTM D4318	Plasticity Index ASTM D4318
TP-2 @ 0-5'	CL	43	24	19

APPENDIX C

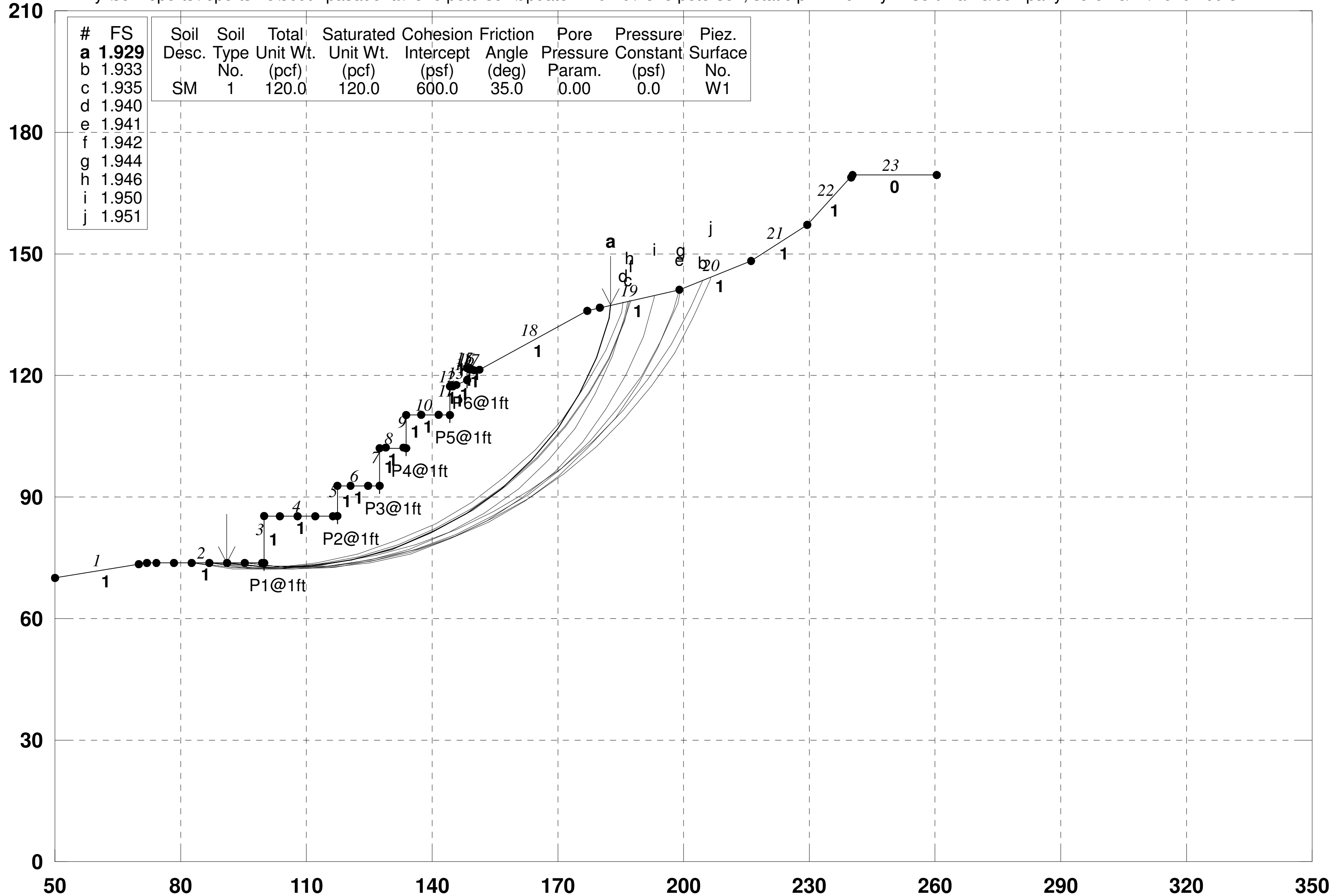
SLOPE STABILITY

1818 Peterson, S. Pasadena Static

y:\soil reports\reports 15\south pasadena\1818 peterson\update 4-20-20\1818 peterson, static.pl2 Run By: Insert Name/company Here 5/11/2020 09:31AM

#	FS
a	**1.929**
b	1.933
c	1.935
d	1.940
e	1.941
f	1.942
g	1.944
h	1.946
i	1.950
j	1.951

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SM	1	120.0	120.0	600.0	35.0	0.00	0.0	W1



GSTABL7 v.2 FSmin=1.929

Safety Factors Are Calculated By The Modified Bishop Method

```
                         ***  GSTABL7  ***
            ** GSTABL7 by Dr. Garry H. Gregory, Ph.D.,P.E.,D.GE **
       ** Original Version 1.0, January 1996; Current Ver. 2.005.3, Feb. 2013 **
               (All Rights Reserved-Unauthorized Use Prohibited)
*********************************************************************************
                    SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*********************************************************************************
Analysis Run Date:          5/11/2020
Time of Run:                09:31AM
Run By:                     Insert Name/company Here
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4-20-20\1818 peterson, static.in
Output Filename:            Y:\SOIL REPORTS\REPORTS 15\South Pasadena\1818 Peterson\Update
4-20-20\1818 peterson, static.OUT
Unit System:                English
Plotted Output Filename:    Y:\SOIL REPORTS\REPORTS 15\South Pasadena\1818 Peterson\Update
4-20-20\1818 peterson, static.PLT
PROBLEM DESCRIPTION:  1818 Peterson, S. Pasadena
                      Static
BOUNDARY COORDINATES
     Note: User origin value specified.
     Add 50.00 to X-values and 0.00 to Y-values listed.

   23 Top   Boundaries
   23 Total Boundaries
Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
   No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
    1         50.00      70.00      72.00      73.75        1
    2         72.00      73.75     100.00      73.75        1
    3        100.00      73.75     100.00      85.25        1
    4        100.00      85.25     117.60      85.25        1
    5        117.60      85.25     117.60      92.75        1
    6        117.60      92.75     127.50      92.75        1
    7        127.50      92.75     127.50     102.20        1
    8        127.50     102.20     133.80     102.20        1
    9        133.80     102.20     133.80     110.30        1
   10        133.80     110.30     144.10     110.30        1
   11        144.10     110.30     144.10     117.30        1
   12        144.10     117.30     145.10     117.30        1
   13        145.10     117.30     148.40     119.00        1
   14        148.40     119.00     148.40     121.80        1
   15        148.40     121.80     149.20     121.80        1
   16        149.20     121.80     149.20     121.30        1
   17        149.20     121.30     151.20     121.30        1
   18        151.20     121.30     177.10     136.00        1
   19        177.10     136.00     199.10     141.30        1
   20        199.10     141.30     216.30     148.30        1
   21        216.30     148.30     229.50     157.30        1
   22        229.50     157.30     240.40     169.30        1
   23        240.40     169.30     260.40     169.30        0
Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
 1 Type(s) of Soil
Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
 No.  (pcf)    (pcf)     (psf)    (deg)    Param.   (psf)     No.
  1   120.0    120.0     600.0     35.0    0.00      0.0      1
Specified Peak Ground Acceleration Coefficient (A) =   0.500(g)
Specified Horizontal Earthquake Coefficient (kh) =   0.000(g)
```

Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
EARTHQUAKE DATA HAS BEEN SUPPRESSED
PIER/PILE LOAD(S)
6 Pier/Pile Load(s) Specified

Pier/Pile No.	X-Pos (ft)	Y-Pos (ft)	Load (lbs)	Spacing (ft)	Inclination (deg)	Length (ft)
1	100.00	73.75	100.0	1.0	90.00	2.0
2	117.60	85.25	100.0	1.0	90.00	2.0
3	127.50	92.75	100.0	1.0	90.00	2.0
4	133.80	102.20	100.0	1.0	90.00	2.0
5	144.10	110.30	100.0	1.0	90.00	2.0
6	148.40	119.00	100.0	1.0	90.00	2.0

NOTE - An Equivalent Line Load Is Calculated For Each Row Of Piers/Piles Assuming A Uniform Distribution Of Load Horizontally Between Individual Piers/Piles.

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.
1000 Trial Surfaces Have Been Generated.
50 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 70.00(ft)
and X = 150.00(ft)
Each Surface Terminates Between X = 180.00(ft)
and X = 240.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Evaluated. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 1000
Number of Trial Surfaces With Valid FS = 1000
Statistical Data On All Valid FS Values:
FS Max = 6.552 FS Min = 1.929 FS Ave = 2.603
Standard Deviation = 0.690 Coefficient of Variation = 26.51 %
Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	91.053	73.750
2	101.002	72.749
3	110.999	72.992
4	120.889	74.474
5	130.518	77.174
6	139.737	81.047
7	148.404	86.036
8	156.384	92.063
9	163.554	99.034
10	169.803	106.841
11	175.033	115.364
12	179.165	124.470
13	182.134	134.019
14	182.731	137.357

Circle Center At X = 104.108 ; Y = 152.805 ; and Radius = 80.126
Factor of Safety
*** 1.929 ***
Individual data on the 23 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	8.9	483.1	0.0	0.0	0.	0.	0.0	0.0	0.0
2	1.0	1497.7	0.0	0.0	0.	0.	0.0	0.0	0.0
3	10.0	14850.7	0.0	0.0	0.	0.	0.0	0.0	0.0
4	6.6	9317.2	0.0	0.0	0.	0.	0.0	0.0	0.0
5	3.3	7310.3	0.0	0.0	0.	0.	0.0	0.0	0.0
6	6.6	13763.2	0.0	0.0	0.	0.	0.0	0.0	0.0

7	3.0	9216.5	0.0	0.0	0.	0.	0.0	0.0	0.0
8	3.3	9585.2	0.0	0.0	0.	0.	0.0	0.0	0.0
9	5.9	21729.6	0.0	0.0	0.	0.	0.0	0.0	0.0
10	4.4	14657.9	0.0	0.0	0.	0.	0.0	0.0	0.0
11	1.0	4014.4	0.0	0.0	0.	0.	0.0	0.0	0.0
12	3.3	13094.0	0.0	0.0	0.	0.	0.0	0.0	0.0
13	0.0	16.2	0.0	0.0	0.	0.	0.0	0.0	0.0
14	0.8	3388.4	0.0	0.0	0.	0.	0.0	0.0	0.0
15	2.0	8137.8	0.0	0.0	0.	0.	0.0	0.0	0.0
16	5.2	20320.2	0.0	0.0	0.	0.	0.0	0.0	0.0
17	7.2	26438.7	0.0	0.0	0.	0.	0.0	0.0	0.0
18	6.2	20356.7	0.0	0.0	0.	0.	0.0	0.0	0.0
19	5.2	13960.3	0.0	0.0	0.	0.	0.0	0.0	0.0
20	2.1	4407.6	0.0	0.0	0.	0.	0.0	0.0	0.0
21	2.1	3483.1	0.0	0.0	0.	0.	0.0	0.0	0.0
22	3.0	2711.6	0.0	0.0	0.	0.	0.0	0.0	0.0
23	0.6	114.4	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	86.842	73.750
2	96.802	72.852
3	106.802	72.861
4	116.760	73.778
5	126.593	75.594
6	136.221	78.296
7	145.565	81.859
8	154.546	86.256
9	163.092	91.450
10	171.131	97.398
11	178.597	104.050
12	185.429	111.353
13	191.569	119.245
14	196.969	127.662
15	201.582	136.535
16	204.420	143.465

Circle Center At X = 101.735 ; Y = 182.640 ; and Radius = 109.904

Factor of Safety

*** 1.933 ***

Failure Surface Specified By 14 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	95.263	73.750
2	105.211	72.735
3	115.209	72.973
4	125.097	74.461
5	134.722	77.175
6	143.931	81.073
7	152.579	86.093
8	160.531	92.157
9	167.662	99.168
10	173.858	107.017
11	179.023	115.580
12	183.075	124.722
13	185.951	134.300
14	186.620	138.294

Circle Center At X = 108.373 ; Y = 152.120 ; and Radius = 79.459

Factor of Safety

*** 1.935 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	82.632	73.750
2	92.580	72.736
3	102.580	72.796
4	112.515	73.929
5	122.272	76.122

6	131.737	79.350
7	140.800	83.576
8	149.358	88.750
9	157.310	94.812
10	164.566	101.694
11	171.041	109.314
12	176.661	117.586
13	181.360	126.413
14	185.085	135.693
15	185.757	138.086

Circle Center At X = 97.023 ; Y = 165.647 ; and Radius = 93.017

Factor of Safety

*** 1.940 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	95.263	73.750
2	105.217	72.793
3	115.217	72.906
4	125.146	74.089
5	134.893	76.327
6	144.343	79.596
7	153.390	83.857
8	161.929	89.061
9	169.862	95.149
10	177.098	102.052
11	183.554	109.688
12	189.156	117.972
13	193.839	126.808
14	197.550	136.094
15	199.001	141.276

Circle Center At X = 109.160 ; Y = 166.032 ; and Radius = 93.323

Factor of Safety

*** 1.941 ***

**** END OF GSTABL7 OUTPUT ****

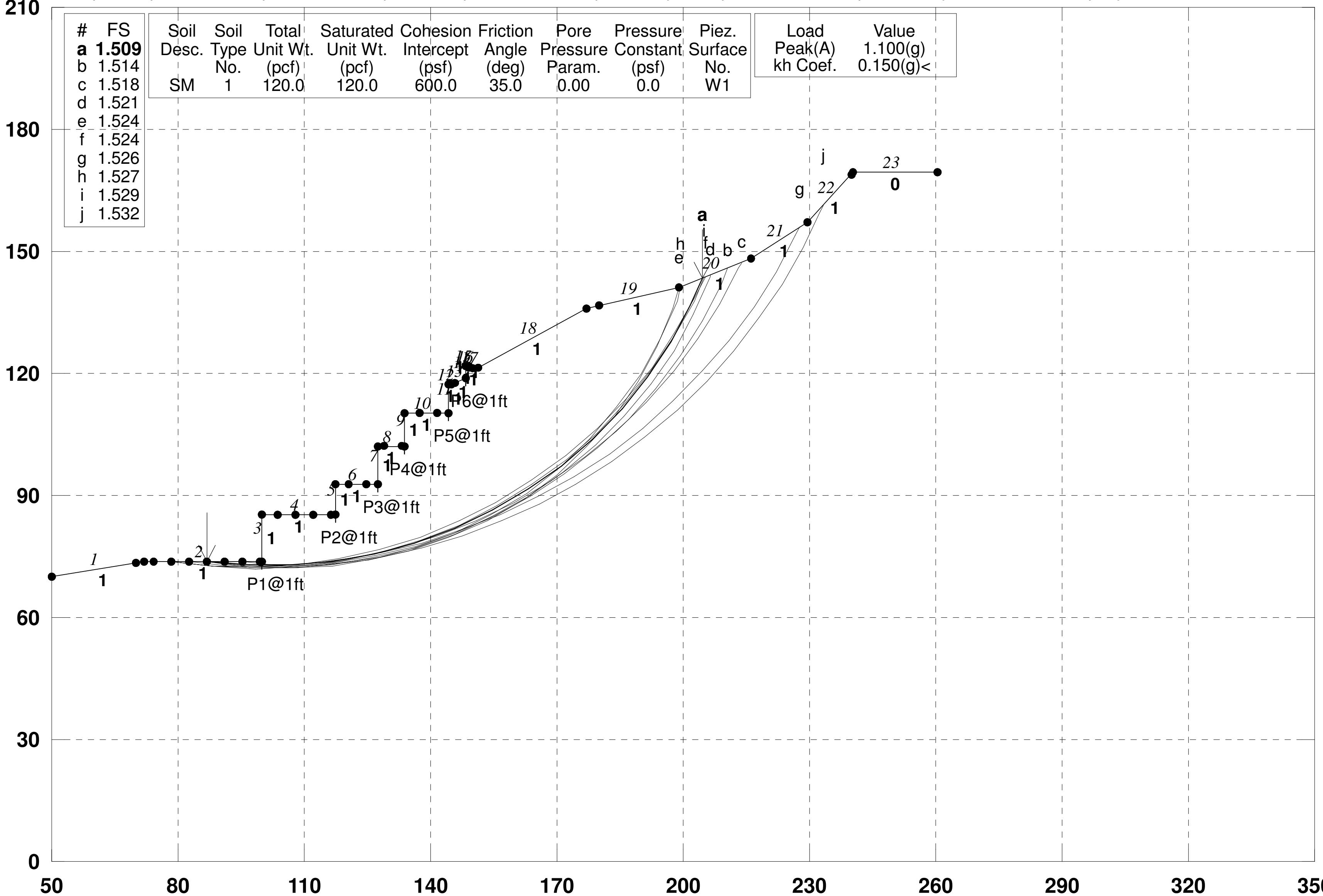
1818 Peterson, S. Pasadena Seismic

y:\soil reports\reports 15\south pasadena\1818 peterson\update 4-20-20\slope stability\1818 peterson, seismic.pl2 Run By: Insert Name/company Here 5/14/2020 02:42PM

#	FS
a	**1.509**
b	1.514
c	1.518
d	1.521
e	1.524
f	1.524
g	1.526
h	1.527
i	1.529
j	1.532

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SM	1	120.0	120.0	600.0	35.0	0.00	0.0	W1

Load	Value
Peak(A)	1.100(g)
kh Coef.	0.150(g)<



GSTABL7 v.2 FSmin=1.509

Safety Factors Are Calculated By The Modified Bishop Method

*** GSTABL7 ***
** GSTABL7 by Dr. Garry H. Gregory, Ph.D.,P.E.,D.GE **
** Original Version 1.0, January 1996; Current Ver. 2.005.3, Feb. 2013 **

****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
****

Analysis Run Date: 5/14/2020
Time of Run: 02:42PM
Run By: Insert Name/company Here
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Output Filename: Y:\SOIL REPORTS\REPORTS 15\South Pasadena\1818 Peterson\Update 4-20-20\Slope Stability\1818 peterson, seismic.OUT
Unit System: English
Plotted Output Filename: Y:\SOIL REPORTS\REPORTS 15\South Pasadena\1818 Peterson\Update 4-20-20\Slope Stability\1818 peterson, seismic.PLT
PROBLEM DESCRIPTION: 1818 Peterson, S. Pasadena
Seismic

BOUNDARY COORDINATES
Note: User origin value specified.
Add 50.00 to X-values and 0.00 to Y-values listed.

23 Top Boundaries
23 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	50.00	70.00	72.00	73.75	1
2	72.00	73.75	100.00	73.75	1
3	100.00	73.75	100.00	85.25	1
4	100.00	85.25	117.60	85.25	1
5	117.60	85.25	117.60	92.75	1
6	117.60	92.75	127.50	92.75	1
7	127.50	92.75	127.50	102.20	1
8	127.50	102.20	133.80	102.20	1
9	133.80	102.20	133.80	110.30	1
10	133.80	110.30	144.10	110.30	1
11	144.10	110.30	144.10	117.30	1
12	144.10	117.30	145.10	117.30	1
13	145.10	117.30	148.40	119.00	1
14	148.40	119.00	148.40	121.80	1
15	148.40	121.80	149.20	121.80	1
16	149.20	121.80	149.20	121.30	1
17	149.20	121.30	151.20	121.30	1
18	151.20	121.30	177.10	136.00	1
19	177.10	136.00	199.10	141.30	1
20	199.10	141.30	216.30	148.30	1
21	216.30	148.30	229.50	157.30	1
22	229.50	157.30	240.40	169.30	1
23	240.40	169.30	260.40	169.30	0

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	600.0	35.0	0.00	0.0	1

Specified Peak Ground Acceleration Coefficient (A) = 1.100(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.150(g)

```
   Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
   Specified Seismic Pore-Pressure Factor =   0.000
  PIER/PILE LOAD(S)
       6 Pier/Pile Load(s) Specified
  Pier/Pile  X-Pos    Y-Pos     Load    Spacing  Inclination  Length
     No.     (ft)     (ft)      (lbs)     (ft)      (deg)      (ft)
      1     100.00    73.75      100.0     1.0      90.00        2.0
      2     117.60    85.25      100.0     1.0      90.00        2.0
      3     127.50    92.75      100.0     1.0      90.00        2.0
      4     133.80   102.20      100.0     1.0      90.00        2.0
      5     144.10   110.30      100.0     1.0      90.00        2.0
      6     148.40   119.00      100.0     1.0      90.00        2.0
   NOTE - An Equivalent Line Load Is Calculated For Each Row Of Piers/Piles
          Assuming A Uniform Distribution Of Load Horizontally Between
          Individual Piers/Piles.
   A Critical Failure Surface Searching Method, Using A Random
   Technique For Generating Circular Surfaces, Has Been Specified.
   1000 Trial Surfaces Have Been Generated.
     50 Surface(s) Initiate(s) From Each Of    20 Points Equally Spaced
   Along The Ground Surface Between  X =  70.00(ft)
                                and  X = 150.00(ft)
   Each Surface Terminates Between   X = 180.00(ft)
                               and   X = 240.00(ft)
   Unless Further Limitations Were Imposed, The Minimum Elevation
   At Which A Surface Extends Is  Y =      0.00(ft)
   10.00(ft) Line Segments Define Each Trial Failure Surface.
   Following Are Displayed The Ten Most Critical Of The Trial
         Failure Surfaces Evaluated. They Are
         Ordered - Most Critical First.
         * * Safety Factors Are Calculated By The Modified Bishop Method * *
         Total Number of Trial Surfaces Attempted =  1000
         Number of Trial Surfaces With Valid FS = 1000
         Statistical Data On All Valid FS Values:
            FS Max =   4.976   FS Min =   1.509   FS Ave =   1.981
            Standard Deviation =    0.472   Coefficient of Variation =   23.81 %
         Failure Surface Specified By 16 Coordinate Points
           Point      X-Surf      Y-Surf
            No.        (ft)        (ft)
             1         86.842      73.750
             2         96.802      72.852
             3        106.802      72.861
             4        116.760      73.778
             5        126.593      75.594
             6        136.221      78.296
             7        145.565      81.859
             8        154.546      86.256
             9        163.092      91.450
            10        171.131      97.398
            11        178.597     104.050
            12        185.429     111.353
            13        191.569     119.245
            14        196.969     127.662
            15        201.582     136.535
            16        204.420     143.465
         Circle Center At X =   101.735 ; Y =   182.640 ; and Radius =   109.904
                Factor of Safety
               ***   1.509   ***
              Individual data on the    26  slices
                        Water  Water     Tie     Tie     Earthquake
                        Force  Force    Force   Force       Force   Surcharge
Slice  Width   Weight    Top    Bot     Norm     Tan      Hor     Ver    Load
 No.    (ft)    (lbs)   (lbs)  (lbs)    (lbs)   (lbs)    (lbs)   (lbs)   (lbs)
  1     10.0     536.7    0.0     0.0      0.      0.    80.5     0.0      0.0
  2      3.2     344.1    0.0     0.0      0.      0.    51.6     0.0      0.0
  3      6.8   10114.3    0.0     0.0      0.      0.  1517.2     0.0      0.0
  4     10.0   14256.2    0.0     0.0      0.      0.  2138.4     0.0      0.0
  5      0.8    1149.1    0.0     0.0      0.      0.   172.4     0.0      0.0
```

6	9.0	19410.5	0.0	0.0	0.	0.	2911.6	0.0	0.0
7	0.9	1852.9	0.0	0.0	0.	0.	277.9	0.0	0.0
8	6.3	19253.4	0.0	0.0	0.	0.	2888.0	0.0	0.0
9	2.4	9398.4	0.0	0.0	0.	0.	1409.8	0.0	0.0
10	7.9	28837.2	0.0	0.0	0.	0.	4325.6	0.0	0.0
11	1.0	4297.0	0.0	0.0	0.	0.	644.6	0.0	0.0
12	0.5	1988.7	0.0	0.0	0.	0.	298.3	0.0	0.0
13	2.8	12151.1	0.0	0.0	0.	0.	1822.7	0.0	0.0
14	0.8	3682.3	0.0	0.0	0.	0.	552.3	0.0	0.0
15	2.0	8921.2	0.0	0.0	0.	0.	1338.2	0.0	0.0
16	3.3	14782.8	0.0	0.0	0.	0.	2217.4	0.0	0.0
17	8.5	37707.4	0.0	0.0	0.	0.	5656.1	0.0	0.0
18	8.0	34638.6	0.0	0.0	0.	0.	5195.8	0.0	0.0
19	6.0	24532.5	0.0	0.0	0.	0.	3679.9	0.0	0.0
20	1.5	5891.5	0.0	0.0	0.	0.	883.7	0.0	0.0
21	6.8	24169.3	0.0	0.0	0.	0.	3625.4	0.0	0.0
22	6.1	17278.2	0.0	0.0	0.	0.	2591.7	0.0	0.0
23	5.4	10809.0	0.0	0.0	0.	0.	1621.3	0.0	0.0
24	2.1	2897.9	0.0	0.0	0.	0.	434.7	0.0	0.0
25	2.5	2280.9	0.0	0.0	0.	0.	342.1	0.0	0.0
26	2.8	983.4	0.0	0.0	0.	0.	147.5	0.0	0.0

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	86.842	73.750
2	96.797	72.804
3	106.797	72.717
4	116.767	73.490
5	126.633	75.118
6	136.324	77.589
7	145.765	80.884
8	154.889	84.978
9	163.626	89.842
10	171.913	95.439
11	179.688	101.728
12	186.893	108.663
13	193.475	116.191
14	199.385	124.257
15	204.580	132.802
16	209.021	141.762
17	210.691	146.017

Circle Center At X = 102.804 ; Y = 188.825 ; and Radius = 116.176

Factor of Safety

*** 1.514 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	82.632	73.750
2	92.588	72.815
3	102.587	72.678
4	112.565	73.339
5	122.458	74.796
6	132.204	77.038
7	141.739	80.051
8	151.003	83.816
9	159.937	88.308
10	168.484	93.500
11	176.589	99.358
12	184.200	105.844
13	191.269	112.917
14	197.750	120.532
15	203.603	128.641
16	208.789	137.191
17	213.276	146.127
18	213.734	147.256

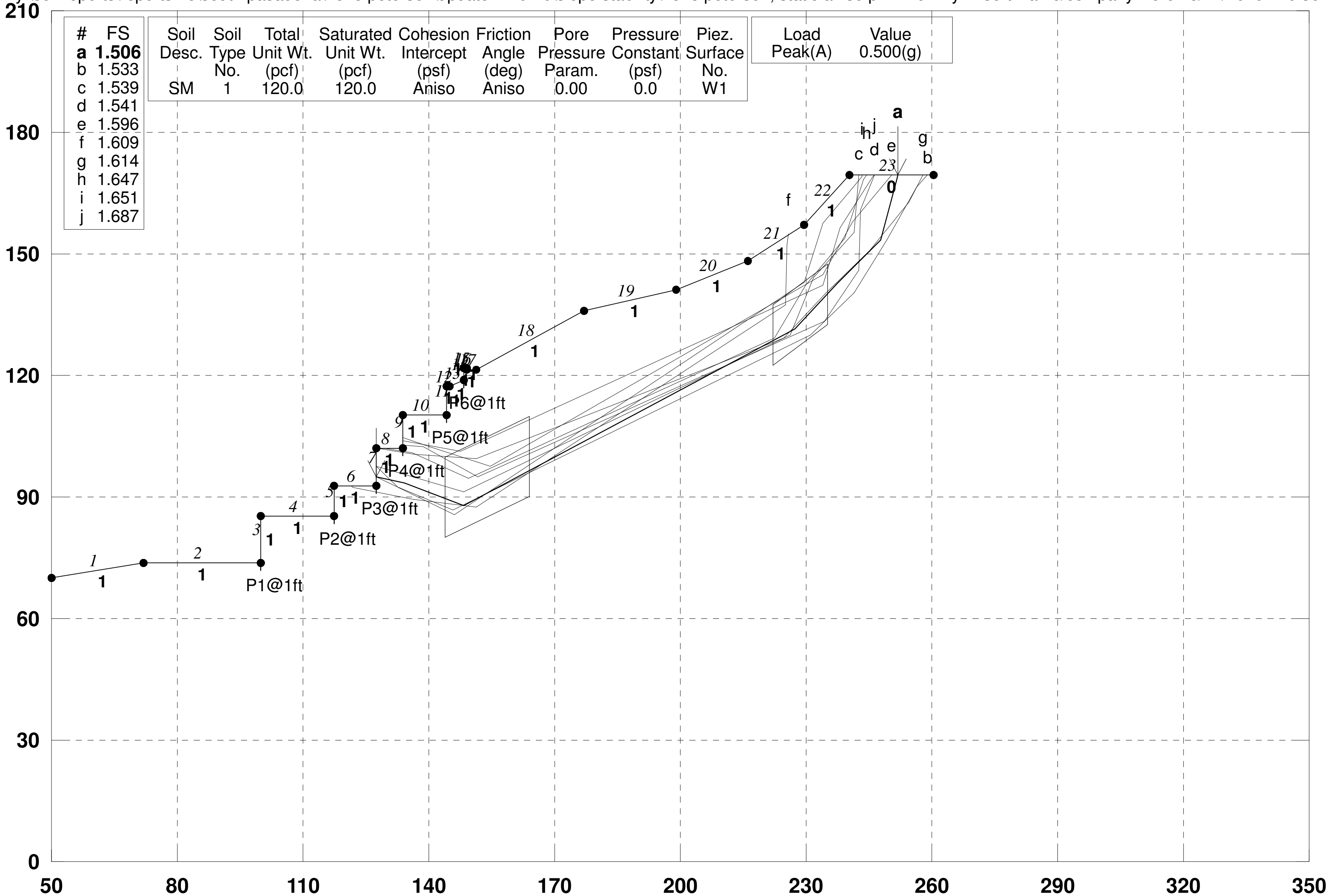
Circle Center At X = 99.323 ; Y = 197.647 ; and Radius = 125.017

Factor of Safety

```
      ***    1.518   ***
Failure Surface Specified By 17 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         86.842      73.750
    2         96.777      72.612
    3        106.775      72.391
    4        116.750      73.090
    5        126.619      74.702
    6        136.299      77.214
    7        145.706      80.605
    8        154.763      84.846
    9        163.391      89.900
   10        171.518      95.727
   11        179.076     102.275
   12        186.001     109.490
   13        192.233     117.310
   14        197.720     125.670
   15        202.416     134.499
   16        206.282     143.722
   17        206.462     144.296
Circle Center At X =   104.173 ; Y =   181.092 ; and Radius =   108.732
       Factor of Safety
      ***    1.521   ***
          **** END OF GSTABL7 OUTPUT ****
```

1818 Peterson, S. Pasadena Static

y:\soil reports\reports 15\south pasadena\1818 peterson\update 4-20-20\slope stability\1818 peterson, static aniso.pl2 Run By: Insert Name/company Here 5/12/2020 10:36AM



#	FS
a	**1.506**
b	1.533
c	1.539
d	1.541
e	1.596
f	1.609
g	1.614
h	1.647
i	1.651
j	1.687

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SM	1	120.0	120.0	Aniso	Aniso	0.00	0.0	W1

Load	Value
Peak(A)	0.500(g)

GSTABL7 v.2 FSmin=1.506

Safety Factors Are Calculated By The Simplified Janbu Method

*** GSTABL7 ***
** GSTABL7 by Dr. Garry H. Gregory, Ph.D.,P.E.,D.GE **
** Original Version 1.0, January 1996; Current Ver. 2.005.3, Feb. 2013 **

****

SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.

****

Analysis Run Date: 5/12/2020
Time of Run: 10:36AM
Run By: Insert Name/company Here
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Output Filename: Y:\SOIL REPORTS\REPORTS 15\South Pasadena\1818 Peterson\Update 4-20-20\Slope Stability\1818 peterson, static aniso.OUT
Unit System: English
Plotted Output Filename: Y:\SOIL REPORTS\REPORTS 15\South Pasadena\1818 Peterson\Update 4-20-20\Slope Stability\1818 peterson, static aniso.PLT
PROBLEM DESCRIPTION: 1818 Peterson, S. Pasadena
Static

BOUNDARY COORDINATES
Note: User origin value specified.
Add 50.00 to X-values and 0.00 to Y-values listed.

23 Top Boundaries
23 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	50.00	70.00	72.00	73.75	1
2	72.00	73.75	100.00	73.75	1
3	100.00	73.75	100.00	85.25	1
4	100.00	85.25	117.60	85.25	1
5	117.60	85.25	117.60	92.75	1
6	117.60	92.75	127.50	92.75	1
7	127.50	92.75	127.50	102.20	1
8	127.50	102.20	133.80	102.20	1
9	133.80	102.20	133.80	110.30	1
10	133.80	110.30	144.10	110.30	1
11	144.10	110.30	144.10	117.30	1
12	144.10	117.30	145.10	117.30	1
13	145.10	117.30	148.40	119.00	1
14	148.40	119.00	148.40	121.80	1
15	148.40	121.80	149.20	121.80	1
16	149.20	121.80	149.20	121.30	1
17	149.20	121.30	151.20	121.30	1
18	151.20	121.30	177.10	136.00	1
19	177.10	136.00	199.10	141.30	1
20	199.10	141.30	216.30	148.30	1
21	216.30	148.30	229.50	157.30	1
22	229.50	157.30	240.40	169.30	1
23	240.40	169.30	260.40	169.30	0

Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
1 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	600.0	35.0	0.00	0.0	1

ANISOTROPIC STRENGTH PARAMETERS
1 soil type(s)

Soil Type 1 Is Anisotropic
Number Of Direction Ranges Specified = 4

Direction Range No.	Counterclockwise Direction Limit (deg)	Cohesion Intercept (psf)	Friction Angle (deg)
1	-90.0	600.00	35.00
2	22.0	600.00	35.00
3	35.0	250.00	23.00
4	90.0	600.00	35.00

ANISOTROPIC SOIL NOTES:
(1) An input value of 0.01 for C and/or Phi will cause Aniso C and/or Phi to be ignored in that range.
(2) An input value of 0.02 for Phi will set both Phi and C equal to zero, with no water weight in the tension crack.
(3) An input value of 0.03 for Phi will set both Phi and C equal to zero, with water weight in the tension crack.

Specified Peak Ground Acceleration Coefficient (A) = 0.500(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.000(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000

PIER/PILE LOAD(S)
6 Pier/Pile Load(s) Specified

Pier/Pile No.	X-Pos (ft)	Y-Pos (ft)	Load (lbs)	Spacing (ft)	Inclination (deg)	Length (ft)
1	100.00	73.75	100.0	1.0	90.00	2.0
2	117.60	85.25	100.0	1.0	90.00	2.0
3	127.50	92.75	100.0	1.0	90.00	2.0
4	133.80	102.20	100.0	1.0	90.00	2.0
5	144.10	110.30	100.0	1.0	90.00	2.0
6	148.40	119.00	100.0	1.0	90.00	2.0

NOTE - An Equivalent Line Load Is Calculated For Each Row Of Piers/Piles Assuming A Uniform Distribution Of Load Horizontally Between Individual Piers/Piles.

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Sliding Block Surfaces, Has Been Specified.
60 Trial Surfaces Have Been Generated.
2 Boxes Specified For Generation Of Central Block Base
Length Of Line Segments For Active And Passive Portions Of Sliding Block Is 15.0

Box No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Height (ft)
1	144.00	90.00	164.00	100.00	20.00
2	222.00	130.00	235.00	140.00	15.00

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Evaluated. They Are Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Simplified Janbu Method * *
Total Number of Trial Surfaces Attempted = 60
Number of Trial Surfaces With Valid FS = 60
Statistical Data On All Valid FS Values:
FS Max = 3.499 FS Min = 1.506 FS Ave = 2.056
Standard Deviation = 0.445 Coefficient of Variation = 21.66 %
Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.500	94.940
2	134.272	93.350
3	148.188	87.752
4	227.230	131.579
5	237.324	142.674
6	247.930	153.282
7	251.512	167.848
8	251.894	169.300

Factor of Safety
*** 1.506 ***
Individual data on the 18 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	6.3	6047.6	0.0	0.0	0.	0.	0.0	0.0	0.0
2	0.5	957.1	0.0	0.0	0.	0.	0.0	0.0	0.0
3	9.8	22320.8	0.0	0.0	0.	0.	0.0	0.0	0.0
4	1.0	3372.5	0.0	0.0	0.	0.	0.0	0.0	0.0
5	3.1	11014.7	0.0	0.0	0.	0.	0.0	0.0	0.0
6	0.2	791.2	0.0	0.0	0.	0.	0.0	0.0	0.0
7	0.8	3236.0	0.0	0.0	0.	0.	0.0	0.0	0.0
8	2.0	7783.8	0.0	0.0	0.	0.	0.0	0.0	0.0
9	25.9	99603.3	0.0	0.0	0.	0.	0.0	0.0	0.0
10	22.0	75946.1	0.0	0.0	0.	0.	0.0	0.0	0.0
11	17.2	49638.4	0.0	0.0	0.	0.	0.0	0.0	0.0
12	10.9	30791.4	0.0	0.0	0.	0.	0.0	0.0	0.0
13	2.3	6456.6	0.0	0.0	0.	0.	0.0	0.0	0.0
14	7.8	21813.8	0.0	0.0	0.	0.	0.0	0.0	0.0
15	3.1	8634.3	0.0	0.0	0.	0.	0.0	0.0	0.0
16	7.5	0.0	0.0	0.0	0.	0.	0.0	0.0	0.0
17	3.6	0.0	0.0	0.0	0.	0.	0.0	0.0	0.0
18	0.4	0.0	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.500	94.998
2	131.880	92.558
3	145.664	86.641
4	230.845	129.874
5	241.372	140.559
6	249.155	153.382
7	256.323	166.559
8	258.793	169.300

Factor of Safety
*** 1.533 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.500	97.421
2	133.956	95.801
3	148.266	91.307
4	226.062	130.036
5	231.637	143.962
6	241.564	155.207
7	242.404	169.300

Factor of Safety
*** 1.539 ***

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.800	104.027
2	147.636	101.397
3	233.853	142.164
4	238.069	156.559
5	246.078	169.243
6	246.124	169.300

Factor of Safety
*** 1.541 ***

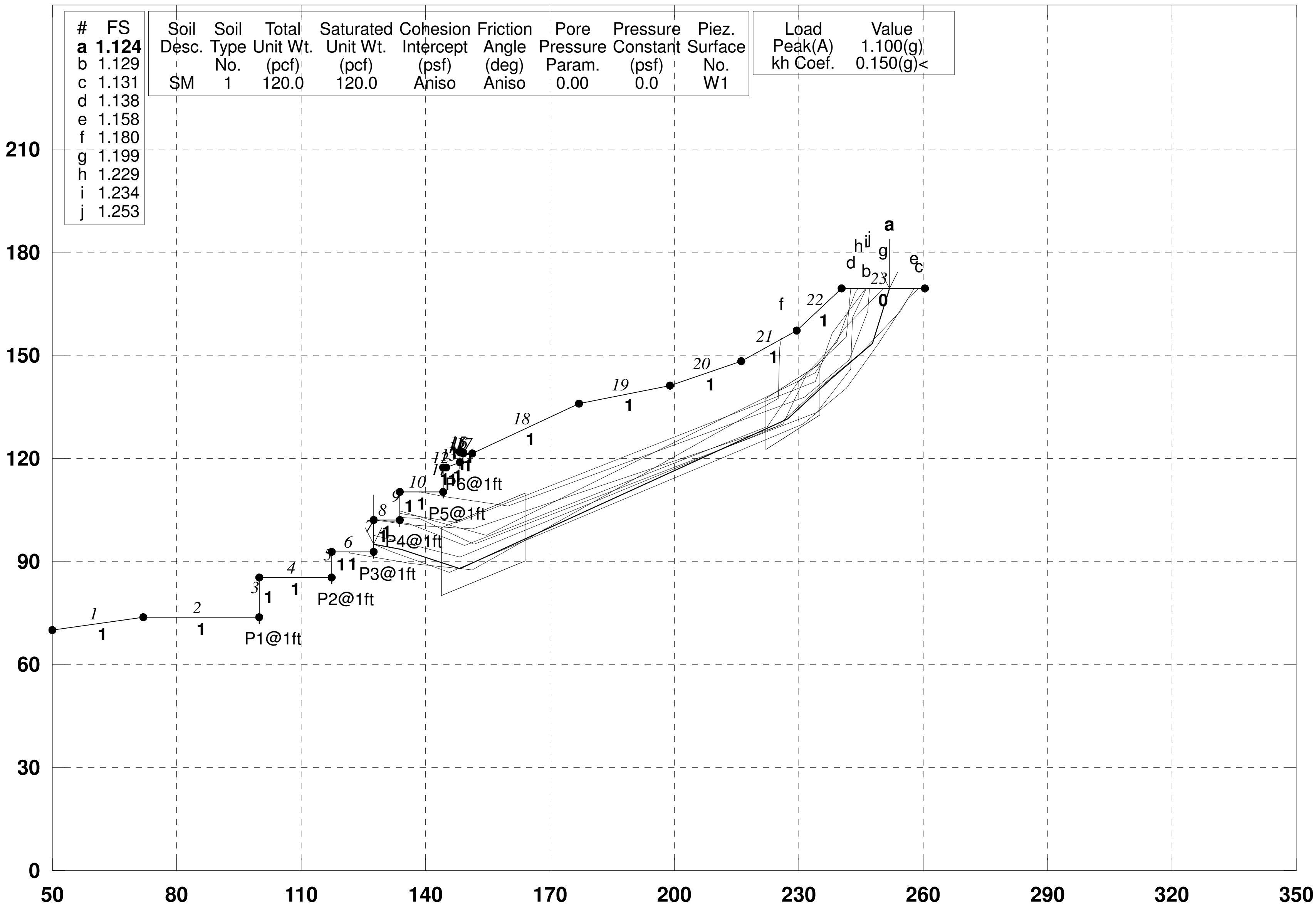
Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.800	104.536
2	140.280	102.263
3	154.590	97.764
4	233.904	144.840
5	241.151	157.973
6	250.520	169.300

```
       Factor of Safety
      ***    1.596   ***
Failure Surface Specified By  7 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        121.374      92.750
    2        121.775      92.348
    3        136.475      89.361
    4        151.372      87.606
    5        225.135     137.453
    6        225.245     152.453
    7        225.809     154.783
       Factor of Safety
      ***    1.609   ***
Failure Surface Specified By  8 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        127.968     102.200
    2        136.446     100.407
    3        151.411      99.383
    4        224.551     129.182
    5        234.658     140.265
    6        245.123     151.012
    7        254.318     162.863
    8        257.839     169.300
       Factor of Safety
      ***    1.614   ***
Failure Surface Specified By  8 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        129.246     102.200
    2        135.988     100.974
    3        149.604      94.681
    4        222.310     129.238
    5        229.989     142.124
    6        239.203     153.960
    7        243.498     168.332
    8        244.402     169.300
       Factor of Safety
      ***    1.647   ***
Failure Surface Specified By  7 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        127.500      97.542
    2        132.750      92.294
    3        146.191      85.635
    4        229.461     143.209
    5        233.865     157.548
    6        243.258     169.242
    7        243.311     169.300
       Factor of Safety
      ***    1.651   ***
Failure Surface Specified By  7 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        133.800     102.774
    2        138.582     102.297
    3        151.728      95.074
    4        234.431     133.226
    5        242.382     145.945
    6        242.963     160.934
    7        246.111     169.300
       Factor of Safety
      ***    1.687   ***
          **** END OF GSTABL7 OUTPUT ****
```

1818 Peterson, S. Pasadena Seismic

y:\soil reports\reports 15\south pasadena\1818 peterson\update 4-20-20\slope stability\1818 peterson, seismic aniso.pl2   Run By: Insert Name/company Here   5/14/2020   02:44PM



#	FS
a	**1.124**
b	1.129
c	1.131
d	1.138
e	1.158
f	1.180
g	1.199
h	1.229
i	1.234
j	1.253

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
SM	1	120.0	120.0	Aniso	Aniso	0.00	0.0	W1

Load	Value
Peak(A)	1.100(g)
kh Coef.	0.150(g)<

GSTABL7 v.2 FSmin=1.124

Safety Factors Are Calculated By The Simplified Janbu Method

```
                   ***  GSTABL7  ***
        ** GSTABL7 by Dr. Garry H. Gregory, Ph.D.,P.E.,D.GE **
    ** Original Version 1.0, January 1996; Current Ver. 2.005.3, Feb. 2013 **
             (All Rights Reserved-Unauthorized Use Prohibited)
*********************************************************************************
                   SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*********************************************************************************
Analysis Run Date:        5/14/2020
Time of Run:              02:44PM
Run By:                   Insert Name/company Here
Input Data Filename:      Y:\SOIL REPORTS\REPORTS 15\South Pasadena\1818 Peterson\Update
4-20-20\Slope Stability\1818 peterson, seismic aniso.in
Output Filename:          Y:\SOIL REPORTS\REPORTS 15\South Pasadena\1818 Peterson\Update
4-20-20\Slope Stability\1818 peterson, seismic aniso.OUT
Unit System:              English
Plotted Output Filename:  Y:\SOIL REPORTS\REPORTS 15\South Pasadena\1818 Peterson\Update
4-20-20\Slope Stability\1818 peterson, seismic aniso.PLT
PROBLEM DESCRIPTION:  1818 Peterson, S. Pasadena
                      Seismic
BOUNDARY COORDINATES
     Note: User origin value specified.
     Add 50.00 to X-values and 0.00 to Y-values listed.

   23 Top   Boundaries
   23 Total Boundaries
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	50.00	70.00	72.00	73.75	1
2	72.00	73.75	100.00	73.75	1
3	100.00	73.75	100.00	85.25	1
4	100.00	85.25	117.60	85.25	1
5	117.60	85.25	117.60	92.75	1
6	117.60	92.75	127.50	92.75	1
7	127.50	92.75	127.50	102.20	1
8	127.50	102.20	133.80	102.20	1
9	133.80	102.20	133.80	110.30	1
10	133.80	110.30	144.10	110.30	1
11	144.10	110.30	144.10	117.30	1
12	144.10	117.30	145.10	117.30	1
13	145.10	117.30	148.40	119.00	1
14	148.40	119.00	148.40	121.80	1
15	148.40	121.80	149.20	121.80	1
16	149.20	121.80	149.20	121.30	1
17	149.20	121.30	151.20	121.30	1
18	151.20	121.30	177.10	136.00	1
19	177.10	136.00	199.10	141.30	1
20	199.10	141.30	216.30	148.30	1
21	216.30	148.30	229.50	157.30	1
22	229.50	157.30	240.40	169.30	1
23	240.40	169.30	260.40	169.30	0

```
Default Y-Origin = 0.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  1 Type(s) of Soil
```

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	120.0	600.0	35.0	0.00	0.0	1

```
ANISOTROPIC STRENGTH PARAMETERS
    1 soil type(s)
```

```
 Soil Type  1 Is Anisotropic
 Number Of Direction Ranges Specified =  4
 Direction    Counterclockwise     Cohesion     Friction
   Range       Direction Limit    Intercept       Angle
    No.            (deg)            (psf)         (deg)
     1             -90.0            600.00         35.00
     2              22.0            600.00         35.00
     3              35.0            250.00         23.00
     4              90.0            600.00         35.00
 ANISOTROPIC SOIL NOTES:
    (1) An input value of 0.01 for C and/or Phi will cause Aniso
        C and/or Phi to be ignored in that range.
    (2) An input value of 0.02 for Phi will set both Phi and
        C equal to zero, with no water weight in the tension crack.
    (3) An input value of 0.03 for Phi will set both Phi and
        C equal to zero, with water weight in the tension crack.
 Specified Peak Ground Acceleration Coefficient (A) =   1.100(g)
 Specified Horizontal Earthquake Coefficient (kh) =   0.150(g)
 Specified Vertical Earthquake Coefficient (kv) =   0.000(g)
 Specified Seismic Pore-Pressure Factor =   0.000
PIER/PILE LOAD(S)
     6 Pier/Pile Load(s) Specified
Pier/Pile  X-Pos    Y-Pos     Load    Spacing  Inclination  Length
   No.     (ft)     (ft)      (lbs)     (ft)      (deg)      (ft)
    1     100.00    73.75      100.0     1.0      90.00        2.0
    2     117.60    85.25      100.0     1.0      90.00        2.0
    3     127.50    92.75      100.0     1.0      90.00        2.0
    4     133.80   102.20      100.0     1.0      90.00        2.0
    5     144.10   110.30      100.0     1.0      90.00        2.0
    6     148.40   119.00      100.0     1.0      90.00        2.0
 NOTE - An Equivalent Line Load Is Calculated For Each Row Of Piers/Piles
        Assuming A Uniform Distribution Of Load Horizontally Between
        Individual Piers/Piles.
 A Critical Failure Surface Searching Method, Using A Random
 Technique For Generating Sliding Block Surfaces, Has Been
 Specified.
   60 Trial Surfaces Have Been Generated.
 2 Boxes Specified For Generation Of Central Block Base
 Length Of Line Segments For Active And Passive Portions Of
 Sliding Block Is  15.0
 Box        X-Left     Y-Left    X-Right    Y-Right      Height
 No.         (ft)       (ft)       (ft)       (ft)        (ft)
  1         144.00      90.00     164.00     100.00       20.00
  2         222.00     130.00     235.00     140.00       15.00
 Following Are Displayed The Ten Most Critical Of The Trial
       Failure Surfaces Evaluated. They Are
       Ordered - Most Critical First.
       * * Safety Factors Are Calculated By The Simplified Janbu Method * *
       Total Number of Trial Surfaces Attempted =    60
       Number of Trial Surfaces With Valid FS =   60
       Statistical Data On All Valid FS Values:
          FS Max =   2.410   FS Min =   1.124   FS Ave =   1.535
          Standard Deviation =    0.308   Coefficient of Variation =   20.03 %
       Failure Surface Specified By  8 Coordinate Points
         Point      X-Surf      Y-Surf
          No.        (ft)        (ft)
           1        127.500      94.940
           2        134.272      93.350
           3        148.188      87.752
           4        227.230     131.579
           5        237.324     142.674
           6        247.930     153.282
           7        251.512     167.848
           8        251.894     169.300
              Factor of Safety
             ***    1.124   ***
            Individual data on the    18  slices
```

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	6.3	6047.6	0.0	0.0	0.	0.	907.1	0.0	0.0
2	0.5	957.1	0.0	0.0	0.	0.	143.6	0.0	0.0
3	9.8	22320.8	0.0	0.0	0.	0.	3348.1	0.0	0.0
4	1.0	3372.5	0.0	0.0	0.	0.	505.9	0.0	0.0
5	3.1	11014.7	0.0	0.0	0.	0.	1652.2	0.0	0.0
6	0.2	791.2	0.0	0.0	0.	0.	118.7	0.0	0.0
7	0.8	3236.0	0.0	0.0	0.	0.	485.4	0.0	0.0
8	2.0	7783.8	0.0	0.0	0.	0.	1167.6	0.0	0.0
9	25.9	99603.3	0.0	0.0	0.	0.	14940.5	0.0	0.0
10	22.0	75946.1	0.0	0.0	0.	0.	11391.9	0.0	0.0
11	17.2	49638.4	0.0	0.0	0.	0.	7445.8	0.0	0.0
12	10.9	30791.4	0.0	0.0	0.	0.	4618.7	0.0	0.0
13	2.3	6456.6	0.0	0.0	0.	0.	968.5	0.0	0.0
14	7.8	21813.8	0.0	0.0	0.	0.	3272.1	0.0	0.0
15	3.1	8634.3	0.0	0.0	0.	0.	1295.1	0.0	0.0
16	7.5	0.0	0.0	0.0	0.	0.	0.0	0.0	0.0
17	3.6	0.0	0.0	0.0	0.	0.	0.0	0.0	0.0
18	0.4	0.0	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 6 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	133.800	104.027
2	147.636	101.397
3	233.853	142.164
4	238.069	156.559
5	246.078	169.243
6	246.124	169.300

Factor of Safety
*** 1.129 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.500	94.998
2	131.880	92.558
3	145.664	86.641
4	230.845	129.874
5	241.372	140.559
6	249.155	153.382
7	256.323	166.559
8	258.793	169.300

Factor of Safety
*** 1.131 ***

Failure Surface Specified By 7 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.500	97.421
2	133.956	95.801
3	148.266	91.307
4	226.062	130.036
5	231.637	143.962
6	241.564	155.207
7	242.404	169.300

Factor of Safety
*** 1.138 ***

Failure Surface Specified By 8 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	127.968	102.200
2	136.446	100.407
3	151.411	99.383
4	224.551	129.182
5	234.658	140.265
6	245.123	151.012

```
    7        254.318      162.863
    8        257.839      169.300
       Factor of Safety
      ***    1.158   ***
Failure Surface Specified By  7 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        121.374       92.750
    2        121.775       92.348
    3        136.475       89.361
    4        151.372       87.606
    5        225.135      137.453
    6        225.245      152.453
    7        225.809      154.783
       Factor of Safety
      ***    1.180   ***
Failure Surface Specified By  6 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        133.800      104.536
    2        140.280      102.263
    3        154.590       97.764
    4        233.904      144.840
    5        241.151      157.973
    6        250.520      169.300
       Factor of Safety
      ***    1.199   ***
Failure Surface Specified By  8 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        129.246      102.200
    2        135.988      100.974
    3        149.604       94.681
    4        222.310      129.238
    5        229.989      142.124
    6        239.203      153.960
    7        243.498      168.332
    8        244.402      169.300
       Factor of Safety
      ***    1.229   ***
Failure Surface Specified By  7 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        133.800      102.774
    2        138.582      102.297
    3        151.728       95.074
    4        234.431      133.226
    5        242.382      145.945
    6        242.963      160.934
    7        246.111      169.300
       Factor of Safety
      ***    1.234   ***
Failure Surface Specified By  7 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1        138.535      110.300
    2        145.073      108.761
    3        159.858      106.234
    4        231.514      137.973
    5        242.040      148.660
    6        246.701      162.917
    7        247.067      169.300
       Factor of Safety
      ***    1.253   ***
          **** END OF GSTABL7 OUTPUT ****
```

APPENDIX D

BEARING CAPACITY AND LATERAL PRESSURES

CALCULATIONS

CAPACITY EVALUATION

1818 Peterson, South Pasadena

Shallow Foundation Equation:

Qult = C x N_c + r x D x N_q

C : Cohesion of Bedrock r : Unit Weight of Bedrock

D : Depth of Foundation Φ : Friction Angle of Bedrock

N_c N_q: Bearing Capacity Coefficient

Reference: Foundation and Earth Structures, Naval Design Manual 7.02, September 1986

C: 600 psf r : 120 pcf Φ : 35°

N_c = 50 N_q = 35

Q = 600 X 50 + 120 X 3 X 40

= 44400 psf

SF = 6

Qall = Q/6 = 7400 psf > 5000 psf, OK

Caisson Bearing Capacity:

Qult= r x D Nq + C x Nq

C: 600 psf r: 120 pcf Φ: 35

N_c: 9 N_q: 25

Q = 120 x 10 x 25 + 600 x 9 =35400

SF: 5

Qall = Q/5 = 7080 psf > 5000psf, OK

LATERAL PRESSURE CALCULATIONS

r: Unit Weight of Bedrock C : Cohesion of Bedrock Φ : Friction Angle of Bedrock

r: 120 pcf   C : 600 psf   Φ : 35°

For Cantilever Retaining Wall up to 20 feet

Long-term, say F.S. = 2   C' = C/2 = 300 pcf $\phi'=\tan^{-1}(\tan 35/2) = 19°$

$Ka = \tan^2(45- \phi'/2) = 0.509$ $F = rHKa -2CKa^{1/2} = 793.6$ lbs

Pa = F/H = 793.6/20 = 39.7 pcf,   Say 40 pcf

Short-term, say F.S. = 1.5   C' = C/1.5 = 400 pcf $\phi'=\tan^{-1}(\tan 35/1.5) = 25°$

$Ka = \tan^2(45- \phi'/2) = 0.406$ $F = rHKa -2CKa^{1/2} = 465.4$ lbs

Pa = F/H = 465.4/20 = 23.3 pcf,   Say 30 pcf

Surcharge at 20 feet: q = 120 x 20 = 2400 psf

Strength of 20 feet τ = 300 + 120 x 20 x tan(19) = 1126 psf

Equivalent Friction Angle $\phi' = \tan^{-1}[1126/ 2400] = 25°$

For Restrained Retaining Wall   At Rest Earth Pressure

Pa=r X Ko $Ko = 1-\sin(\phi') = 0.58$ Pa = 120 X 0.58 = 70 pcf

Seismic Lateral Pressure

$P_E = 3/8 \times r \times H^2 \times k_h$ $PGA_M = 1.100g$ $k_h = 1/2 \times 2/3 \times PGA_M = 0.366g$

$P_E = 16.47 H^2$ $P_E(EFP) = 33H$

Passive Earth Pressure

Earth Pressure Pp = r x Ka $Kp = \tan^2(45 + \phi'/2) = 2.46$

Pp = 120 x 2.46 = 295 pcf   Say 290 pcf, OK

Friction $\mu = 0.67 \times \tan(\phi') = 0.31 > 0.30$ OK

Reference: (1) "Geotechnical Engineering Analysis and Evaluation", Roy Hunt, McGraw Hill Book Company, 1986

(2) Retaining Wall Design, City of Los Angeles Document No. P/BC 2020-083

(3) "Principles of Foundation Engineering", by B.M. Das, PWS Publishers, 1984