WAYNE TING & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

Project No. 3807
5 March 2017

Mr. Sommadh Allu
3056 Flint Street
Union City, CA 94587

Subject: **GEOTECHNICAL INVESTIGATION**
Proposed Two Story Single Family Structure
APN 81D-1665-26
Between 26610 and 26630 Call Avenue
Hayward, California

Dear Mr. Allu:

In accordance with your authorization, **Wayne Ting & Associates, Inc. (WTAI)** has completed a geotechnical investigation for the proposed single family structure with a basement at the subject site. The purpose of this study was to investigate the subsurface conditions and obtain geotechnical data for use in the design and construction of the proposed two-story single family structure. The scope of this investigation included the following:

a. A site and area reconnaissance by the Project Engineer.
b. An excavation, logging and sampling of 2 exploratory borings.
c. Laboratory testing of selected soil samples.
d. An engineering analysis of the data and information obtained.
e. Preparation and writing of this report which presents our findings, conclusions, and recommendations.

## SITE LOCATION AND DESCRIPTION

The subject vacant lot is located Between 26610 and 26630 Call Avenue, Hayward, California. The property is boarded to southwest by Call Avenue and the west and east by single family homes. The ground surfaces have inclination of approximately 2:1 (horizontal : vertical) from the street to approximately 50 feet into the property then changes to 3:1 sloping upward east.

## PROPOSED STRUCTURE

The proposed project consists of constructing a two-story single family structure. We anticipate that the proposed structure will utilize wood-framed construction for the house. Light to moderate building loads are typically associated with these types of construction.

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## FIELD INVESTIGATION

WTAI conducted the field investigation on February 28, 2017. The field investigation consisted of a site reconnaissance by the Project Engineer and excavation of two exploratory. The borings were excavated using a minuteman drill-rig with 3-inch stem augers. The approximate locations of the borings are shown on the Site Plan, Figure 1.

Soils encountered during the excavation operation were continuously logged in the field. Relatively undisturbed samples were obtained by dynamically driving 18 inches using a 3.0-inch outside diameter Modified California Sampler with a 140-pound hammer free falling 30 inches. Blow counts were recorded for every 6-inch penetration interval, and reported corresponding to the last 12 inches of penetration. These samples were then sealed and returned to the laboratory for testing. The classifications, descriptions, natural moisture contents, dry densities, and depths of the obtained samples are shown in the Boring Logs, Figures 2 and 3 of Appendix A.

## LABORATORY TESTING

### *CLASSIFICATION*

The field classifications of the samples were visually verified in the laboratory in accordance with the Unified Soil Classification System. These classifications are presented in the Boring Logs, Figures 2 through 4.

### *MOISTURE-DENSITY*

The natural moisture contents and dry weights were determined for selected soil samples obtained during our field investigation. The data are presented in the aforementioned Boring Logs.

### *ATTERBERG LIMITS*

The Atterberg Limits test based on ASTM D4318 was determined for the selected soil sample to classify, as well as to obtain an indication of the expansion and shrinkage potential with respect to moisture content variations. The liquid limit and plasticity index of the soil were found to be:

| ***Sample*** | ***Depth*** | ***Classification*** | ***Liquid Limit*** | ***Plasticity Index*** |
|---|---|---|---|---|
| B1-1 | 1.5 feet | Medium brown clay (CH-CL) | 45.0% | 26 |

The Atterberg Limits tests indicate that representative samples of the soils are moderate to high plasticity. The expansion potentials for these soils are thus moderate to high.

## SUBSURFACE SOIL CONDITIONS

The following soil descriptions were derived from our site reconnaissance and information obtained from our exploratory boring samples. Detailed descriptions of the materials encountered in the exploratory borings and results of the laboratory testing are presented in Figures 2 and 3.

Borings 1 and 2, soils encountered at the site consisted of 1.5 feet of medium brown silty clay, stiff and moist, followed by medium brown sandstone, weathered, fractured, and dense, to the maximum depth explored of 2.0 feet below the ground surface (bgs).

No groundwater was encountered in the exploratory borings at the time of our field study. Fluctuations in the groundwater table are anticipated to vary with respect to seasonal rainfall.

## SEISMIC CONSIDERATIONS

According to the published maps by the International Conference of Building Officials (I.C.B.O.), in February 1998, the distances from active faults to the subject site are listed in the following table.

| Fault Name | Distance (kilometers ) | Direction From Site |
|---|---|---|
| Northern Hayward | 1.1 | Southwest |
| Northern Calaveras | 10.7 | East |

## CALIFORNIA BUILDING CODE SITE CHARACTERIZATION

The following design values are based on the geologic information, longitude and latitude of the site, and the USGS computer program. Furthermore, in accordance with Chapter 16 of the 2016 California Building Code (CBC), the site seismic design values are provided below:

| CBC Category/Coefficient 2010 ASCE 7-10 (with March 2013 errata) | Design Value |
|---|---|
| Short-Period MCE at 0.2s, Ss | 2.378 |
| 1.0s Period MCE, S1 | 0.989 |
| Soil Profile Type, Site Class | D |
| Site Coefficient, Fa | 1.0 |
| Site Coefficient, Fv | 1.3 |
| $S_{MS} = Fa \times S_s$ Spectral Response Accelerations | 2.378 |
| $S_{M1} = Fv \times S_1$ Spectral Response Accelerations | 1.286 |
| $S_{DS} = 2/3 \times S_{MS}$ Design Spectral Response Accelerations | 1.585 |
| $S_{D1} = 2/3 \times S_{M1}$ Design Spectral Response Accelerations | 0.857 |
| Latitude: 37.65755, Longitude: -122.04566 | |

It is noted that final values should be determined by the project structural engineer according to risk categories of the proposed two-story single family structure.

## LIQUEFACTION EVALUATION

Liquefaction is a phenomenon in which saturated (submerged), cohesionless soils are subjected to a temporary loss of strength due to the buildup of pore water pressures, especially as a result of cyclic loadings induced by earthquakes or ground shaking. In the process, the soil acquires a mobility sufficient to permit both horizontal and vertical deformations, if not confined. Soils most susceptible to liquefaction are clean, loose, saturated, uniformly graded, fine sands.

Based on our review of this data, the boring logs, and the absence of ground water, it is the opinion of WTAI that the probability of liquefaction of the clay and rock underlying this site is low.

## DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

1. Based on the results of our investigation, WTAI concludes that the subject site is geotechnically suitable for the proposed two-story single family structure provided the recommendations presented in this report are incorporated into the project plans and specifications.

2. WTAI should review the grading and foundation plans and specifications so that comments can be made regarding the interpretation and implementation of our geotechnical recommendations in the design and specifications.

3. It is recommended that WTAI be retained for observation during foundation construction phases to help determine that the design requirements are fulfilled. Our firm should be notified at least two working days prior to grading and/or foundation operations on the property.

4. Any work related to the grading and foundation operations performed without the direct observation of WTAI will invalidate the recommendations of this report.

5. The recommendations given in this report are applicable only for the design of the previously described two-story single family structure with a basement and only at the location indicated on the site plan. They should not be used for any other purpose.

## SITE PREPARATION AND GRADING

6. Prior to grading, the proposed structure, pavement, and fill areas should be cleared of all trees and deleterious materials.

7. After clearing, these areas should be stripped of all organic topsoil. It is estimated that stripping depths of 4 to 6 inches may be necessary. However, final stripping depths should be determined by

WTAI in the field. The predominantly organic material from the stripping should be removed from the site.

8. After completion of the stripping, the top 8 inches of exposed native ground should be scarified. After scarifying, the exposed native subgrade soils will be watered or aerated as necessary to bring the soils to a moisture content of 2 percent above the optimum moisture amount. The subgrade should then be uniformly recompacted to a minimum relative compaction of 90 percent of the maximum dry density as determined by ASTM D1557 latest edition Laboratory Test Procedure. If rock is encountered at the subgrade, no compaction is needed.

## FOUNDATION SYSTEMS

9. Due to on-site sloping condition, the proposed two-story single family structure can satisfactorily be supported on a pier and grade beam foundation system located on the existing ground level provided that the site is prepared as previously recommended.

10. The drilled piers should have a minimum diameter of 16.0 inches and a minimum embedment of 10.0 feet into rock, approximately 12 below lowest adjacent grades, whichever is deeper. These piers should be designed for an allowable skin friction value of 600 pounds per square foot for dead plus live loads. This value can be increased by one-third for total loads which include wind or seismic forces. Due to the on-site sloping condition and expansive clay, this value is applicable only after a minimum penetration of 3.0 feet below the lowest adjacent finished grade has been achieved. The validity of this value is based on a minimum spacing of 3 pier diameters measured center-to-center. The bottoms of grade beams should be extended 12 inches into interior pad grade.

11. Due to the highly expansive surface material, the bottom of the grade beam should be designed to resist swelling pressure of 1,200 p.s.f.

12. Due to the slope gradient, any piers located near or on the slope may be subject to creep loads imposed by the soils. For all piers constructed at or within 10.0 feet from the top of the slope, a triangular pressure distribution of 65 p.c.f. equivalent fluid weights should be designed against the side of these piers over 2 pier diameters along the length in the upper 3.0 feet of the piers.

13. Resistance to lateral forces may be provided by passive earth pressures mobilized in the firm natural ground below a depth of 3.0 feet. Passive earth pressures may be computed as an equivalent fluid weighing of 300 pounds per cubic foot acting on 2 pier diameters.

14. Movements under the anticipated building loads are expected to be within tolerable limits for the proposed structure. We estimate that the total movement will be less than 1.0-inch, and post-construction differential settlements across the building should not exceed approximately 0.5-inch during the life of the building following construction.

15. After completion of the drilling of piers, the bottom of the pier excavations should be cleaned of excessive loose materials prior to placing the reinforcing steel and concrete.

## SITE RETAINING WALL

16. The site retaining walls should be designed to resist lateral earth pressure from the backfill soils. The lateral earth pressure presented as an equivalent fluid weight of 45 p.c.f. for flat backfill and 65 p.c.f. for 2:1 (horizontal:vertical) backfill should be used.

17. The above criterion is based upon a sufficient drainage system to be constructed behind the wall to prevent the build-up of hydrostatic pressures. The wall drainage system should consist of a gravel blanket with a minimum width of 12 inches and should extend vertically to 12.0 inches below the ground surface. The top 12 inches should be backfilled with on-site soils to provide a surface seal and be graded away from the wall. If the excavated area behind the wall exceeds 12 inches, the entire excavated area, behind the 12-inch blanket material, should be backfilled with gravel. The gravel blanket may consist of drainrock wrapped effectively with filter fabric.

18. Four-inch diameter perforated pipes should be placed on bedding at the bottom of the gravel blanket adjacent to the bottom of the retaining wall. The perforations should be placed facing down toward the bottom of the excavation. The pipes should have a minimum gradient of 1.0 percent and should connect to an adequately controlled outlet facility.

19. The wall should be supported on footings which should be designed for allowable bearing pressures of 2,000 p.s.f. due to dead plus live loads and 2,700 p.s.f. due to all loads which include wind or seismic forces. The bottom of the footings should be founded at least 12 inches into rock.

20. Resistance to lateral force may be provided by passive earth pressure mobilized in the firm natural ground below the depth of 12 inches into rock. Passive earth pressure may be computed as an equivalent fluid weighing of 300 p.c.f. Sliding resistance between the base of the footings and the underlying rock may be taken as a friction value of 0.3.

## CONCRETE SLABS ON GRADE

21. To reduce the potential cracking of the concrete slabs, the following recommendations are made:

a. Concrete slab-on-grades should be underlain by at least 4 inches of clean crushed, 3/4-inch size rock, to act as a cushion and capillary break between the subsoil and the slab. If expansive clay is encountered under the slab, it should be removed and replaced with 18 inches of baserock. The baserock should be compacted to at least 95%.

b. Cconcrete slab-on-grade should be constructed structurally independent to the foundation and be floating with expansion joint (felt strip or equal) to separate the slab from the grade beam. This method would allow possible vertical movement due to soil swell.

c. Slabs at garage door openings should be constructed with a thickened edge extending a minimum of 8 inches into the native ground or compacted fill.

## DRIVEWAY

22. Prior to any paving construction, the upper 12 inches of the subgrade soil should be scarified and recompacted to 90% of the maximum dry density at 3% above the optimum moisture content as defined by ASTM D1557 latest version Test Procedure.

23. After the compaction of the subgrade, aggregate base should then be placed on top of the subgrade and compacted to a minimum relative compaction of 95% at optimum moisture content as defined by the aforementioned ASTM Test Procedure.

24. Pavement Sections: A pavement section of 3.0 inches of asphaltic concrete over 12.0 inches of aggregate base material may be utilized.

## GENERAL CONSTRUCTION REQUIREMENTS

25. All finished grading must be adjusted to provide positive drainage away from the structure to prevent ponding of water toward the building.

26. All roof drains should be collected by a system of gutters and downspouts and discharged to a splash box to carry storm water away from the building structure.

27. Backfill of utility trenches under the building areas should be compacted to at least 90 percent compaction to ensure against water migration underneath the building structure.

28. Flowerbeds and planting are not recommended along the building perimeter. Only drip systems can be installed where they may cause saturation of the foundation soils. Landscape mounds or concrete flatwork should not block or obstruct the surface drainage measures.

29. A foundation drain should be provided around the perimeter grade beam of pier foundation. The foundation drain should be constructed a lateral distance of 6.0 inches from the foundation and extend to a minimum depth of 12 inches the bottom of the grade beam. The recommended subdrain detail is presented in Figure 6 of Appendix A. The perforated pipe shown in Figure 6 shall pass into a solid line pipe at the end drain and then be directed to a suitable discharge area. Cleanout risers should be provided at the upgradient end of the perforated pipe, at sharp bends in the subdrain pipe, and at 100 foot maximum intervals.

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**LIMITATIONS AND UNIFORMITY OF CONDITIONS**

30. Our client should recognize that this report is prepared for the exclusive use of the proposed two-story single family structure with a basement and pool. Our professional services, findings, and recommendations were prepared in accordance with generally accepted engineering principles and practices. No other warranty, expressed or implied, is made.

31. The conclusions and recommendations contained in this report will not be considered valid after a period of two years unless the changes are reviewed, and the conclusions of this report are modified or verified in writing.

32. This report is issued with the understanding that it is the responsibility of the owner, or his representative, to ensure the information and recommendations contained in this report are brought to the attention of the Architect, Engineer, and Contractor. In all cases, the contractor shall retain responsibility for the quality of the work and for repairing defects regardless of when they are found. It is also the responsibility of the contractor for conforming to the project plans and specifications. Should you have any questions relating to the contents of this report, please contact our office at your convenience.

Very truly yours,

**WAYNE TING & ASSOCIATES, INC.**

Wayne Ting

Wayne Ting, C.E.
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
WAYNE L. TING
No. C 46276
Exp: 12/31/18
CIVIL
STATE OF CALIFORNIA

Copy: 1 to Mr. Allu

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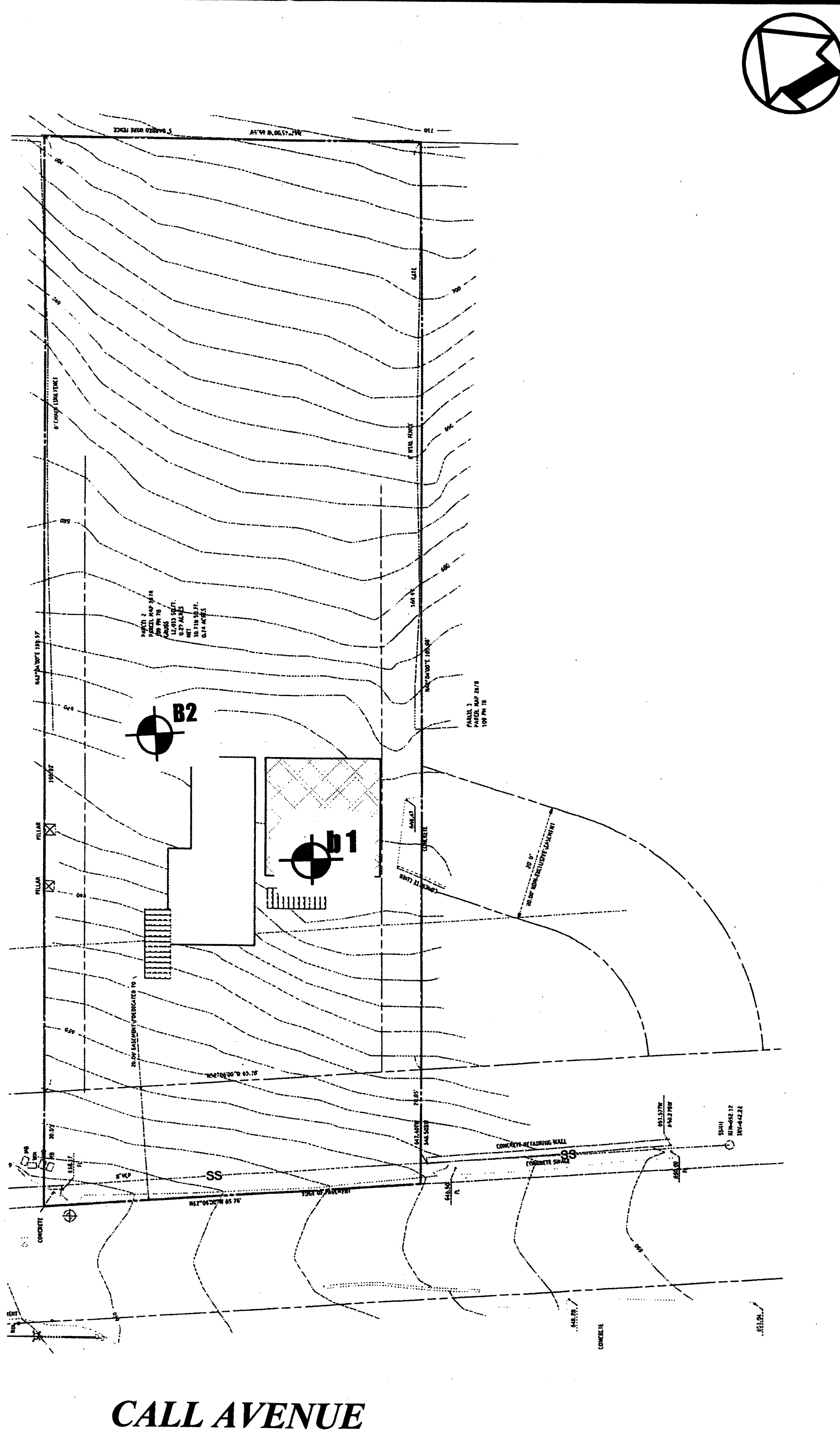
# APPENDIX A

Site Plan, Figure 1

Boring Logs, Figures 2 and 3

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|---|---|---|
| WAYNE TING & ASSOCIATES, INC. | **Site Plan** | Figure No. 1 |
| GEOTECHNICAL CONSULTANTS | Scale: 1"=30' | Page No. 10 |

| Depth (Feet) | Description | Sample No. | Unified Soil Classification | Blows/Foot (350 Ft.-Lbs) | Dry Density (P.C.F) | Moisture (% Dry Density) | Pocket Penet. (T.S.F) | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1 | Medium brown silty clay, stiff and moist | 1-1 | CH-CL | | | | | LL=45%<br>PI=26 |
| | Medium brown sandstone, weathered, dense | | | >50 | | | | |
| 2 | Boring refusal at 2.0 feet. | | | | | | | |
| 3 | No ground water encountered. | | | | | | | |
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| **WAYNE TING & ASSOCIATES, INC.** | ***BORING LOG NO. 1*** | *Figure No. 2* |
| **GEOTECHNICAL CONSULTANTS** | *Date Drilled:* 28 February 2017 *By:* TB | *Page No. 11* |

APN 81D-1665-26. Call Avenue, Hayward, California — Project No. 3807 — 5 March 2017

| Depth (Feet) | Description | Sample No. | Unified Soil Classification | Blows/Foot (350 Ft.-Lbs) | Dry Density (P.C.F) | Moisture (% Dry Density) | Pocket Penet. (T.S.F) | Remarks |
|---|---|---|---|---|---|---|---|---|
| 0–1 | Medium brown silty clay, stiff and moist | | CH-CL | | | | | |
| 1–2 | Medium brown sandstone, weathered, dense | 2-1 | | >50 | | | | |
| 2 | Boring refusal at 2.0 feet. | | | | | | | |
| | No ground water encountered. | | | | | | | |
| 3–25 | | | | | | | | |

**WAYNE TING & ASSOCIATES, INC.**

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***BORING LOG NO. 2***

*Date Drilled:* 28 February 2017 *By:* TB

*Figure No. 3*