Project No. 1855
7 May 2013

Mr. Hardy Gill
Shaw Group, LP
P. O. Box 2622
Sumas, WA 98295

Subject: **GEOTECHNICAL REPORT REVIEW**
Proposed Single-Family Subdivision
Tract No. 8022
2512 and 2492 D Street
Alameda County, California

References:

1) Geotechnical Investigation
By Cleary Consultants, Inc.
Dated 7 July 1989
2) Geologic Investigation
By Buckley Engineering Associates, Dated 21 August 2002
3) Update of Geotechnical Investigation and Supplemental Recommendations
By Wayne Ting & Associates, Inc.
Dated 1 April 2010
4) Uncontrolled Fill Investigation
By Wayne Ting & Associates, Inc.
Dated 5 August 2010
5) Proposed Subdivision
By Wayne Ting & Associates, Inc.
Dated 16 January 2006

Dear Mr. Gill:

At your request, Wayne Ting & Associates, Inc. (WTAI) has reviewed the referenced materials to provide geotechnical recommendations for the design and construction of the subject project. The tentative map is provided in Figure 1, Appendix A.

It is noted that site plan, test pit logs, and boring logs obtained from References 2 and 4 are provided in Appendix B. In addition, it is noted that the uncontrolled fills mentioned in Reference 4 have been removed to the native soils.

EARTHQUAKE-INDUCED LANDSLIDE ANALYSIS

Background

It is noted that the proposed subject site consisted of moderate to 2:1 (horizontal:vertical) slopes. Detail site descriptions are provided in the referenced reports. The subject site is located within the earthquake-induced landslide zones based on the California Seismic Hazard Zones, Hayward Quadrangle map, dated July 2, 2003, the proposed development will need to address the potential of permanent ground displacement during earthquakes. Our evaluation is based on California Department of Conservation, Division of Mines and Geology 's Special Publication 117A (SP 117), Guidelines for Evaluation and Mitigating Seismic Hazards in California. We conducted seismic slope stability analysis that is consistent with the "Recommended Procedure for Implementation of DMG Special Publication 117A Guidelines for Analyzing and Mitigating Landslide Hazards in California," developed by the ASCE Implementation Committee, chaired by Thomas F. Blake, dated June 2002 (Blake et al 2002).

The results of analysis based on the following geotechnical parameters were presented in References 3 and 4. The detail analysis and printout are not provided in this report.

Soil and Rock Geotechnical Parameters

The laboratory test results, our field observations and engineering experience form the basis for using the following engineering properties in our stability analysis:

Material	Unit Weight (p.c.f.)	Cohesion (p.s.f.)	Friction Angle (degrees)	Case No.
Silty clay (native)	120	540	16.0	1
Silty clay (Recommended by Cal Engineering)	120	250	25.0	2
Sandstone	130	1,000	35	

Stability Analysis Results

The results of the stability analysis are summarized as follows:

Failure Plane	Loading Condition	Pseudo Static Factor of Safety	Case No.
Circular	Undrained Strength	1.92	1
Circular	Undrained Strength	1.89	2

A factor of safety of 1.2 or greater for the pseudo-static analyses is considered to be adequate. The result of the pseudo-static factor of safety at the subject site is average of 1.9. Therefore, the analysis indicates the existing slopes meet the minimum factor of safety criteria stated in SP 117A. It is our opinion that permanent ground deformation during strong earthquakes would be small, if any.

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

GENERAL CONSIDERATIONS

1. From a geotechnical engineering standpoint, it is the opinion of WTAI that the subject site is suitable for the proposed construction provided the project design and construction incorporate the recommendations contained herein.

2. It is recommended that the WTAI be given the opportunity to review the grading and foundation plans and specifications when completed, to evaluate compliance with the recommendations provided in this report.

3. It is further recommended that WTAI be retained for testing and observation during all grading and foundation construction phases to help determine that the design requirements are fulfilled. WTAI should be notified at least 48 hours prior to grading and/or foundation operations on this project.

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

SITE PREPARATION AND GRADING

5. Prior to grading, the proposed structure, pavement, and fill areas should be cleared of all obstructions and deleterious materials. It is noted that the test pits mentioned in Reference 2 were loosely backfilled. Therefore, these loose fill in these pits and any uncontrolled fills should be overexcavated and backfilled with engineered fills and compacted to not less than 95 percent relative compaction.

6. 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.

7. After completion of the stripping, the top 8 inches of exposed native ground should be scarified. After scarifying, it should be disced or bladed until it is uniform and free of large clods. The exposed native subgrade soils will be watered or aerated as necessary to bring the soils to a moisture content of 3 percent above the optimum moisture amount. The subgrade should then be uniformly recompacted to a minimum degree of relative compaction of 90 percent of the maximum dry density as determined by ASTM D1557 Latest Edition Laboratory Test Procedure. Materials generated from the excavation may be used as engineered fill with the approval of WTAI provided they are not contaminated by debris.

8. Following recompaction of the native subgrade soils, the site may be filled to the desired finished grade using suitable on-site native soil. All fills should be placed in lifts not exceeding 8 inches in uncompacted thickness and compacted to the abovementioned compaction requirements. Each layer will be spread evenly and will be blade mixed thoroughly to provide uniformity of soil in each layer. Compaction of each layer will be continuous over the fill area and continued until the required density is obtained.

9. Cut and fill transition at garage concrete slabs-on-grade area may experience abrupt differential settlement causing significant distress. This condition can be mitigated by scarifying the cut portion of the transition garage pad a minimum depth of 12 inches. The scarified material should be properly moisture-conditioned to at least 2 percent above optimum moisture content and be recompacted to a minimum relative compaction of 90 percent. It is noted that a minimum three feet of uniform engineered fill should be constructed under the entire garage area. The fill should be placed in thin lifts not exceeding 8 inches in uncompacted thickness and compacted to the abovementioned compaction requirements.

SLOPES

10. In general, all fill slopes should not be steeper than 2:1 (horizontal:vertical). Cut slopes in stiff natural materials should not exceed 2:1 (H:V).

11. A shear key must be established at the toe of all fill slopes where the natural hill slope exceeds 6:1 (horizontal: vertical). The shear key must be at least 12 feet in width and 3 feet cut into the

underlying rock. The bottom of the keyway excavation should be sloping back into the hillside at a minimum gradient of 5 percent. The location and depth of the keyway and subdrain should be determined by WTAI during grading operations. Subsequent benches should be placed at vertical heights of 3 feet and should extend horizontally into the rock. A typical section is presented in Figure 2, Fill Slope Detail.

12. During the grading operations, fill slopes must be compacted and should be over-constructed. At the completion of grading operations, the excess fill or loose soils existing on the slopes should be cut to a firm and adequately designed slope grade. Track-walking of the slope surface should only be utilized to seal the surface.

13. Before work is stopped due to heavy rains, a positive gradient away from slopes should be provided to carry surface runoff water away from the slope and to areas where erosion can be controlled. After the completion of slope grading, the exposed cut and fill slopes should be planted with deep-rooted native plants to minimize erosion. Some minor erosion on slopes should be expected. Thus, periodic maintenance is required.

CALIFORNIA BUILDING CODE SITE CHARACTERIZATION

14. The following design values are base on the geologic information, longitude and latitude of the site and the USGS computer program (2007). Furthermore, in according to Chapter 16 of the 2010 California Building Code (CBC), the site seismic design values have been provided as follows:

CBC Category/Coefficient	Design Value
Figure 1613.5.(3), Short-Period MCE at 0.2s, Site Class B, Ss	1.875
Figure 1613.5.(4), 1.0s Period MCE, Site Class B, S1	0.712
Table 1613.5.2, Soil Profile Type, Site Class	D
Table 1613.5.3(1), Site Coefficient, Fa	1.0
Table 1613.5.3(2), Site Coefficient, Fv	1.5
S_{MS} = Fa x S_s Spectral Response Accelerations	1.875
S_{M1} = Fv x S_1 Spectral Response Accelerations	1.068
S_{DS} = 2/3 x S_{MS} Design Spectral Response Accelerations	1.250
S_{D1}= 2/3 x S_{M1} Design Spectral Response Accelerations	0.712

** Latitude 37.6797, Longitude: -122.05624

FOUNDATIONS

15. The drilled piers should have a minimum diameter of 16 inches and a minimum embedment of a minimum 10.0 feet into rock. These piers should be designed for an allowable skin friction value of 500 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. This value is only applicable for piers are penetrating into rock. The validity of this value is based on a minimum pier spacing of 3 pier diameters measured center-to-center. In addition, piers should be tied together with the tie beams.

16. Due to the slope gradient and the expansive soil, 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 feet from the top of the slope, a triangular pressure distribution of 65 p.c.f. equivalent fluid weight should be designed against the side of these piers along the length in the upper 4 feet of the piers.

17. Resistance to lateral force may be provided by passive earth pressure mobilized along the pier length below the depth of 4 feet. Passive earth pressure may be computed as an equivalent fluid weighing of 300 p.c.f. For design of isolated piers, the allowable passive pressure may be increased by a factor of 1.5.

18. After the pier drilling has completed, the bottom of the pier holes should be cleaned of excessive loose materials prior to placing the reinforcing steel and concrete.

19. Depressions at the top of piers resulting from drilling operations should be backfilled to prevent ponding of water. Care should be exercised during concrete placement to prevent the concrete from spilling around the pier shafts. If excess spillage occurs, the fresh concrete should be removed.

20. Difficult drilling may be encountered in the dense rock. Heavy duty drilling equipment should therefore be used to drill the pier holes.

RETAINING WALL

21. The following design parameter should be used for structural design of proposed retaining walls at the subject site. The drainage detail behind the wall is provided in Figure 3.

TABLE I

Slope Inclination Behind Wall (Horizontal : Vertical)	Equivalent Fluid Weight (Pounds Per Cubic Foot)	
	Unrestrained	Restrained
Flat	45	65
2:1	65	85

In addition, earthquakes induced lateral loads should be added for the basement wall design. These lateral loads should be taken as that imposed by an equivalent fluid weight of 30 p.c.f. However, the distribution of this load should be considered as a triangle with resultant force acting at a point 0.6 of the wall height above the base of the wall.

22. The above criterion is based upon a sufficient drainage system to be constructed behind the walls 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 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 space behind the 12-inch blanket material should be backfilled with gravel. The gravel blanket may consist of crushed rock wrapped effectively with filter fabric.

23. A 4-inch diameter perforated pipe should be placed on bedding at the bottom of the gravel blanket adjacent to the base of the footing or grade beam. The perforations should be placed facing down toward bottom of the excavation. The bedding material should be at least 4 inches thick. The pipe should have a minimum gradient of 1.0 percent and should connect to an adequately controlled outlet facility away from the foundations.

CONCRETE SLABS ON GRADE

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

a. Slabs-on-grade in the garage area should be reinforced by the structural engineer and should not be doweled into the perimeter foundation.

b. 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.

c. Concrete slab-on-grade 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.

TRENCH BACKFILL

25. Backfilling and compaction of utility trenches must meet the requirements published by the County of Alameda, Department of Public Works. All trench backfill under pavement areas must be backfilled with baserock or imported granular materials and compacted to at least 90% relative compaction as determined by ASTM D1557 Latest Edition Laboratory Test Procedure. The top 12 inches of the subgrade should be compacted to 95%.

26. Backfill of utility trenches extending under the building area should be properly compacted to ensure against water migration underneath the foundation structure.

PAVEMENT SECTION

27. The top 10 inches of street subgrade should be scarified and recompacted to a minimum relative compaction of 95% and at 2% above the optimum moisture content as determined by ASTM D1557 Latest Edition Laboratory Test Procedure.

28. Aggregate subbase should then be placed on top of the subgrade and compacted to a minimum relative compaction of 95%. Class II aggregate base must also be compacted to 95% relative compaction. The class II aggregate base should conform to the requirements of Standard Specifications of Caltrans, Section 26-1.02A.

29. Pavement Sections: The following recommended pavement sections are based on Traffic Indices (T.I.) of 4, 5 and 6, and assuming R-value of 5.

Traffic Index	Asphaltic Concrete	Class II Aggregate	Aggregate Subbase
4	3.0"	8.0"	11.0"
5	3.0"	12.0"	15.0"
6	4.0"	13.0"	17.0"

DRAINAGE

30. A foundation drain system should be constructed around the perimeter foundations. The foundation drain should be constructed at a lateral distance of 6.0 inches from the foundation and extended a minimum depth of 18 inches below the bottom of the grade beam. The recommended subdrain detail is presented in Figure 3. The perforated pipe shown in Figure 4 will pass into a solid line pipe at the end drain then be directed to a suitable discharge area. Cleanout risers should be provided at the upgradient end of the perforated pipe, at sharp bends, and at 100 foot maximum intervals.

31. All downspouts from the roof gutter system should be tied into a closed pipe system and discharged to an adequate drainage system.

32. Exterior flatwork should be sloping away from the building so that water will be drained away from the structure. Landscape mounds or concrete flatwork should not be constructed to block or obstruct the surface drainage measures.

33. Planted areas should be avoided immediately adjacent to the structure. If planting adjacent to the residence is desired, use of plants that require little moisture is recommended. Sprinkler systems should not be installed where they may cause ponding or saturation of foundation soils. Such ponding or saturation could result in undesirable soil movement, loss of compaction, and/or subsequent foundation and slab movement. Irrigation of landscape areas should be limited strictly to that necessary for plant growth. Excessive irrigation could result in saturation, weakening and possible swelling of the foundation soils.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

33. Our client should recognize that this report is prepared for the exclusive use of this project. 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.

34. 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.

35. 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.

36. Our client should recognize that every effort made to evaluate the subsurface conditions at this site is based on the samples recovered from the test borings and the results of laboratory tests on these samples. The conclusions reached in this report were based on the conditions at the test boring locations. The owner or his representative should be reminded that unanticipated subsurface conditions are commonly encountered and cannot be fully determined by taking subsurface samples, and frequently require that additional expenditures be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate these required extra costs.

Should you have any questions relating to the contents of this report, please contact our office at your convenience.

Very truly yours,

Wayne L. Ting, C.E.

Principal Engineer

Copies: 4 to Mr. Gill

APPENDIX A

APPENDIX B

Site Plan, Boring Logs and Test Pits in References 2 and 4.