CORNERSTONE EARTH GROUP

Type of Services	**Geotechnical Investigation**
Project Name	**Fair Oaks West Apartments Seismic Upgrades**
Location	**655 South Fair Oaks** **Sunnyvale, California**
Client	**Prometheus Real Estate Group**
Client Address	**1900 S. Norfolk Street, Suite 150** **San Mateo, CA**
Project Number	**307-10-1**
Date	**July 25, 2014**

DRAFT

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SECTION 1: INTRODUCTION

This geotechnical report was prepared for the sole use of Prometheus Real Estate Group for the Fair Oaks West Apartments in Sunnyvale, California. The location of the site is shown on the Vicinity Map, Figure 1. For our use, we were provided with and utilized the following documents:

- Structural plan sheets S1.0, S1.1, S1.2, S2.1, S2.2, and S8.1 titled, "Voluntary Garage Seismic Strengthening, Fair Oaks West Apartments," prepared by Tuan & Robinson Structural Engineers, Inc., dated February 8, 2001.

- As-built structural plan sheets B-1 and B-6 titled, "Fair Oaks West Apartments," prepared by Kenneth P. Elvin and Associates, dated October 12, 1970.

1.1 PROJECT DESCRIPTION

The project will consist of construction of seismic upgrades on sixteen apartment buildings at the approximately 24-acre site in Sunnyvale, California. Each apartment building was built over a partially subterranean parking level and consists of three levels of wood-framed structures. The planned improvements will include new foundations and additional concrete or concrete masonry unit (CMU) shear walls within the parking level of each building and possible uplift resistance systems.

We understand from the RFP that settlement has been observed around some columns in three buildings at the parking level. We specifically targeted these buildings for additional borings at the parking level to provide subsurface data in these areas. Further details are presented in this report.

Grading is anticipated to include minor cuts and fills on the order of 1 to 3 feet. Structural loads were not available at the time of this report but are expected to be typical for similar type structures.

1.2 SCOPE OF SERVICES

Our scope of services was presented in our proposal dated May 21, 2014 and consisted of field and laboratory programs to evaluate physical and engineering properties of the subsurface soils, engineering analysis to prepare recommendations for site work and grading, and building foundations, and preparation of this report. Brief descriptions of our exploration and laboratory programs are presented below.

1.3 EXPLORATION PROGRAM

Field exploration consisted of ten borings drilled on June 23 and 24, 2014 with truck-mounted hollow-stem auger and limited-access “minute-man” drilling equipment. The borings were drilled to depths ranging from 6½ to 40 feet. The borings were backfilled with cement grout in accordance with local requirements; exploration permits were obtained as required by local jurisdictions.

The approximate locations of our exploratory borings are shown on the Site Plan, Figure 2. Details regarding our field program are included in Appendix A.

1.4 LABORATORY TESTING PROGRAM

In addition to visual classification of samples, the laboratory program focused on obtaining data for foundation design and seismic ground deformation estimates. Testing included moisture contents, dry densities, washed sieve analyses, and Plasticity Index tests. Details regarding our laboratory program are included in Appendix B.

1.5 ENVIRONMENTAL SERVICES

Environmental services were not requested for this project. If environmental concerns are determined to be present during future evaluations, the project environmental consultant should review our geotechnical recommendations for compatibility with the environmental concerns.

SECTION 2: REGIONAL SETTING

2.1 GEOLOGICAL SETTING

The site is located within the Santa Clara Valley, which is a broad alluvial plane between the Santa Cruz Mountains to the southwest and west, and the Diablo Range to the northeast. The San Andreas Fault system, including the Monte Vista-Shannon Fault, exists within the Santa Cruz Mountains and the Hayward and Calaveras Fault systems exist within the Diablo Range. Alluvial soil thicknesses in the area of range from about 400 to 480 feet (Rogers & Williams, 1974).

2.2 REGIONAL SEISMICITY

The San Francisco Bay area is one of the most seismically active areas in the Country. While seismologists cannot predict earthquake events, the U.S. Geological Survey's Working Group on California Earthquake Probabilities 2007 estimates there is a 63 percent chance of at least one magnitude 6.7 or greater earthquake occurring in the Bay Area region between 2007 and 2036. As seen with damage in San Francisco and Oakland due to the 1989 Loma Prieta earthquake that was centered about 50 miles south of San Francisco, significant damage can occur at considerable distances. Higher levels of shaking and damage would be expected for earthquakes occurring at closer distances.

The faults considered capable of generating significant earthquakes are generally associated with the well-defined areas of crustal movement, which trend northwesterly. The table below presents the State-considered active faults within 25 kilometers of the site.

Table 1: Approximate Fault Distances

Fault Name	Distance	
	(miles)	(kilometers)
Monte Vista-Shannon	4.7	7.5
San Andreas (1906)	8.0	12.8
Hayward (Southeast Extension)	9.9	15.9
Hayward (Total Length)	12.2	19.7
Calaveras (South)	13.6	21.9

A regional fault map is presented as Figure 3, illustrating the relative distances of the site to significant fault zones.

SECTION 3: SITE CONDITIONS

3.1 SURFACE DESCRIPTION

The 24-acre site has sixteen apartment buildings and includes three swimming pools, tennis courts, surficial parking lots around the perimeter of the site, drive aisles, associated utilities and landscaping. Each of the apartment buildings is set over a partially subterranean parking level, with a grade difference of between 2 to 4 feet below relative site grades. Overall, the site is relatively level, but graded to drain to storm drainage facilities.

Surface pavements generally consisted of 1 to 5½ inches of asphalt concrete over 3 to 6½ inches of aggregate base. Garage pavements generally consisted of 5 ½ inches of Portland cement concrete over 1½ inches of aggregate base. Based on visual observations, the existing pavements are in fair to poor shape with isolated areas of alligator cracking.

During our site visits, we observed settlement in buildings 12, 13 and 16 near some columns. They appear to range from ¼- to ¾-inch of settlement from the existing slab on grade. From the as-built plans provided, we understand the interface between the column block out and the slab was a cold joint and the parking level slab is un-reinforced concrete.

3.2 SUBSURFACE CONDITIONS

Below the surface pavements and garage slabs, our explorations generally encountered low to moderate plasticity, very stiff to hard lean clay with variable amounts of sand and medium dense clayey sand to the maximum depth explored of 40 feet. Several layers of medium dense to very hard poorly graded sand with silt and gravel were encountered in at variable depths and thickness in EB-3 and EB-4, EB-5 and EB-8. EB-5 encountered this type of sand from 10½ feet to 30 feet, the terminal depth of the boring. Our explorations EB-6 and EB-10 encountered fill which consisted of hard lean clay with variable amounts of sand. These two borings were located under Building 12 to depths of 5 feet and under Building 13 to 2 feet, respectively. Trench backfill was encountered in EB-7 to a depth of 6½ feet, the terminal depth of the boring.

3.2.1 Plasticity/Expansion Potential

We performed two Plasticity Index (PI) tests on representative samples. Test results were used to evaluate expansion potential of surficial soils. The results of the surficial PI tests indicated PIs ranging from 14 to 16, indicating low to moderate expansion potential to wetting and drying cycles.

3.2.2 In-Situ Moisture Contents

Laboratory testing indicated that the in-situ moisture contents within the upper 10 feet range from 1 to 3 over the estimated laboratory optimum moisture.

3.3 GROUND WATER

Ground water was encountered in one of our explorations, EB-8, at a depth of 39 feet below current grades. All measurements were taken at the time of drilling and may not represent the stabilized levels that can be higher than the initial levels encountered. The historic high ground water is mapped at a depth of about 30 feet below existing site grades (CGS, 2002).

Fluctuations in ground water levels occur due to many factors including seasonal fluctuation, underground drainage patterns, regional fluctuations, and other factors.

SECTION 4: GEOLOGIC HAZARDS

4.1 FAULT RUPTURE

As discussed above, several significant faults are located within 25 kilometers of the site. The site is not located within a State-designated Alquist Priolo Earthquake Fault Zone, or a Santa Clara County Fault Hazard Zone. As shown in Figure 3, no known surface expression of fault traces is thought to cross the site; therefore, fault rupture hazard is not a significant geologic hazard at the site.

4.2 ESTIMATED GROUND SHAKING

Moderate to severe (design-level) earthquakes can cause strong ground shaking, which is the case for most sites within the Bay Area. A peak ground acceleration (PGA) was estimated for analysis using a value equal to F_{PGA}*PGA, as allowed in the 2013 edition of the California Building Code. For our analysis, we used a PGA of 0.52g.

4.3 LIQUEFACTION POTENTIAL

The site is not located within a State-designated Liquefaction Hazard Zone (CGS, Cupertino Quadrangle, 2002) or a Santa Clara County Liquefaction Hazard Zone (Santa Clara County, 2003). However, we screened the site for liquefaction during our site exploration by retrieving samples from the site, performing visual classification on sampled materials, and performing various tests to further classify the soil properties.

During strong seismic shaking, cyclically induced stresses can cause increased pore pressures within the soil matrix that can result in liquefaction triggering, soil softening due to shear stress loss, potentially significant ground deformation due to settlement within sandy liquefiable layers as pore pressures dissipate, and/or flow failures in sloping ground or where open faces are present (lateral spreading) (NCEER 1998). Limited field and laboratory data is available regarding ground deformation due to settlement; however, in clean sand layers settlement on the order of 2 to 3 percent of the liquefied layer thickness can occur. Soils most susceptible to liquefaction are loose, non-cohesive soils that are saturated and are bedded with poor drainage, such as sand and silt layers bedded with a cohesive cap.

As discussed in the “Subsurface” section above, we primarily encountered stiff cohesive and dense granular soils. Although we encountered granular soils below 20 feet, these were mostly dense to very dense sands that we believe will not be subject to liquefaction. Based on the above, our screening of the site for liquefaction indicates a low potential for liquefaction, and is in general agreement with local mapping for the site by ABAG.

4.4 LATERAL SPREADING

Lateral spreading is horizontal/lateral ground movement of relatively flat-lying soil deposits towards a free face such as an excavation, channel, or open body of water; typically lateral spreading is associated with liquefaction of one or more subsurface layers near the bottom of the exposed slope. As failure tends to propagate as block failures, it is difficult to analyze and estimate where the first tension crack will form.

There are no open faces within a distance considered susceptible to lateral spreading; therefore, in our opinion, the potential for lateral spreading to affect the site is low.

4.5 SEISMIC SETTLEMENT/UNSATURATED SAND SHAKING

Loose unsaturated sandy soils can settle during strong seismic shaking. As the soils encountered at the site were predominantly stiff to very stiff clays and medium dense to dense sands, in our opinion, the potential for significant differential seismic settlement affecting the proposed improvements is low.

4.6 FLOODING

Based on our internet search of the Federal Emergency Management Agency (FEMA) flood map public database, the site is located within Zone X, described as, "Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood." We recommend the project civil engineer be retained to confirm this information and verify the base flood elevation, if appropriate.

The Association of Bay Area Governments has compiled a database of Dam Failure Inundation Hazard Maps (ABAG, 1995). The generalized hazard maps were prepared by dam owners as required by the State Office of Emergency Services; they are intended for planning purposes only. Based on our review of these maps, the site is not located within a dam failure inundation area.

SECTION 5: CONCLUSIONS

5.1 SUMMARY

From a geotechnical viewpoint, the seismic upgrade project is feasible provided the concerns listed below are addressed in the project design. Descriptions of each concern with brief outlines of our recommendations follow the listed concerns.

- Potential for future settlement at specific Buildings L, M and P
- Presence of undocumented fill

5.1.1 Presence of Undocumented Fill

As stated previously, we encountered up to 5 feet of undocumented fill in our borings under building L and M. We anticipate there may be undocumented fill under portions of the buildings. During the excavation of the new foundations, undocumented fill may be encountered. For planning purposes, undocumented fill should be removed and replaced with engineered fill or control density fill, if observed. Additionally, the footing can be excavated down to undisturbed native soils. Further recommendations are presented in the section below.

5.1.2 Potential for Future Settlement

We understand that surface displacement was observed at the control joints around the base of several interior columns in Buildings L, M, and P. We noted that the settlement at these columns was on the order of ¼-inch to ¾-inch. The foundation plans show the existing foundations are short piers with belled ends. Based on scaling from the plan sheet, as the schedule sheet was not available, we estimate the pier bells had an average of 5 foot diameters and that the capacity of these piers ranged from 125 to 150 kips for dead plus live loads. We estimated that the expected static settlement at these columns before construction was on the order of ½-inch. This could vary between ¼ to ¾-inch across the site, which appears to be the magnitude of the settlement currently visible. As the building has been in service for over 40 years, and the subsurface material is mostly stiff clays and medium dense sands, we conclude that this settlement is normal for this type of structure and anticipate the majority of settlement for the structure is complete, only minor additional settlement may occur in the future. At the owners' options, we can perform monitoring program; this is discussed below.

As an option, we can perform a floor level survey to monitor settlement at these locations over a longer time period. This would consist of using a water level to verify the relative settlement currently from a fixed point within each parking level and return after several months or years to confirm the amount of settlement, and show if there is any continued settlement at these buildings.

5.2 PLANS AND SPECIFICATIONS REVIEW

We recommend that we be retained to review the geotechnical aspects of the project structural and civil plans and specifications, allowing sufficient time to provide the design team with any comments prior to issuing the plans for construction.

5.3 CONSTRUCTION OBSERVATION AND TESTING

As site conditions may vary significantly between the small-diameter borings performed during this investigation, we also recommend that a Cornerstone representative be present to provide geotechnical observation and testing during earthwork and foundation construction. This will allow us to form an opinion and prepare a letter at the end of construction regarding contractor compliance with project plans and specifications, and with the recommendations in our report. We will also be allowed to evaluate any conditions differing from those encountered during our investigation, and provide supplemental recommendations as necessary. For these reasons, the recommendations in this report are contingent of Cornerstone providing observation and testing during construction. Contractors should provide at least a 48-hour notice when scheduling our field personnel.

SECTION 6: EARTHWORK

6.1 TEMPORARY CUT AND FILL SLOPES

The contractor is responsible for maintaining all temporary slopes and providing temporary shoring where required. Temporary shoring, bracing, and cuts/fills should be performed in accordance with the strictest government safety standards. On a preliminary basis, the upper 10 feet at the site may be classified as OSHA Soil Type B materials.

6.2 REMOVAL OF EXISTING FILLS

Any fills encountered during the excavation of the proposed footings should be excavated at least 2 feet below the bottom of the proposed footing and replaced with engineered fill or control density fill. Provided the fills meet the “Material for Fill” requirements below, the fills may be reused when backfilling the excavations. Based on review of the samples collected from our borings, it appears that the fill may be reused. If materials are encountered that do not meet the requirements, such as debris, wood, trash, those materials should screened out of the remaining material and be removed from the site. Backfill of excavations should be placed in lifts and compacted in accordance with the “Compaction” section below.

6.3 MATERIAL FOR FILL

6.3.1 Re-Use of On-site Soils

On-site soils with an organic content less than 3 percent by weight may be reused as general fill. General fill should not have lumps, clods or cobble pieces larger than 6 inches in diameter; 85 percent of the fill should be smaller than 2½ inches in diameter. Minor amounts of oversize material (smaller than 12 inches in diameter) may be allowed provided the oversized pieces are not allowed to nest together and the compaction method will allow for loosely placed lifts not exceeding 12 inches.

6.3.2 Potential Import Sources

Imported and non-expansive material should be inorganic with a Plasticity Index (PI) of 15 or less, and not contain recycled asphalt concrete where it will be used within the parking garage areas. To prevent significant caving during trenching or foundation construction, imported material should have sufficient fines. Samples of potential import sources should be delivered to our office at least 10 days prior to the desired import start date. Information regarding the import source should be provided, such as any site geotechnical reports. If the material will be derived from an excavation rather than a stockpile, potholes will likely be required to collect samples from throughout the depth of the planned cut that will be imported. At a minimum, laboratory testing will include PI tests. Material data sheets for select fill materials (Class 2 aggregate base, ¾-inch crushed rock, quarry fines, etc.) listing current laboratory testing data (not older than 6 months from the import date) may be provided for our review without providing a sample. If current data is not available, specification testing will need to be completed prior to approval.

Environmental and soil corrosion characterization should also be considered by the project team prior to acceptance. Suitable environmental laboratory data to the planned import quantity should be provided to the project environmental consultant; additional laboratory testing may be required based on the project environmental consultant's review. The potential import source should also not be more corrosive than the on-site soils, based on pH, saturated resistivity, and soluble sulfate and chloride testing.

6.4 COMPACTION REQUIREMENTS

All fills, and subgrade areas where fill, slabs-on-grade, and pavements are planned, should be placed in loose lifts 8 inches thick or less and compacted in accordance with ASTM D1557 (latest version) requirements as shown in the table below. In general, clayey soils should be compacted with sheepsfoot equipment and sandy/gravelly soils with vibratory equipment; open-graded materials such as crushed rock should be placed in lifts no thicker than 18 inches consolidated in place with vibratory equipment. Each lift of fill and all subgrade should be firm and unyielding under construction equipment loading in addition to meeting the compaction requirements to be approved. The contractor (with input from a Cornerstone representative) should evaluate the in-situ moisture conditions, as the use of vibratory equipment on soils with high moistures can cause unstable conditions. General recommendations for soil stabilization are provided in the "Subgrade Stabilization Measures" section of this report.

Table 2: Compaction Requirements

Description	Material Description	Minimum Relative[1] Compaction (percent)	Moisture[2] Content (percent)
General Fill (within upper 5 feet)	On-Site Soils	90	>1
Trench Backfill	On-Site Soils	90	>1
Trench Backfill (upper 6 inches of subgrade)	On-Site Soils	95	>1
Crushed Rock Fill	¾-inch Clean Crushed Rock	Consolidate In-Place	NA
Pavement Subgrade	On-Site Soils	95	>1
Pavement Aggregate Base	Class 2 Aggregate Base[3]	95	Optimum

1 – Relative compaction based on maximum density determined by ASTM D1557 (latest version)
2 – Moisture content based on optimum moisture content determined by ASTM D1557 (latest version)
3 – Class 2 aggregate base shall conform to Caltrans Standard Specifications, latest edition, except that the relative compaction should be determined by ASTM D1557 (latest version)

6.5 TRENCH BACKFILL

Any new utility lines for this project should be bedded and shaded to at least 6 inches over the top of the lines with crushed rock (⅜-inch-diameter or greater) or well-graded sand and gravel materials conforming to the pipe manufacturer's requirements. Open-graded shading materials should be consolidated in place with vibratory equipment and well-graded materials should be compacted to at least 90 percent relative compaction with vibratory equipment prior to placing subsequent backfill materials.

General backfill over shading materials may consist of on-site native materials provided they meet the requirements in the “Material for Fill” section, and are moisture conditioned and compacted in accordance with the requirements in the “Compaction” section.

Where utility lines will cross perpendicular to strip footings, the footing should be deepened to encase the utility line, providing sleeves or flexible cushions to protect the pipes from anticipated foundation settlement, or the utility lines should be backfilled to the bottom of footing with sand-cement slurry or lean concrete. Where utility lines will parallel footings and will extend below the “foundation plane of influence,” an imaginary 1:1 plane projected down from the bottom edge of the footing, either the footing will need to be deepened so that the pipe is above the foundation plane of influence or the utility trench will need to be backfilled with sand-cement slurry or lean concrete within the influence zone. Sand-cement slurry used within foundation influence zones should have a minimum compressive strength of 75 psi.

SECTION 7: FOUNDATIONS

7.1 SUMMARY OF RECOMMENDATIONS

In our opinion, the proposed shear walls may be supported on shallow foundations provided the recommendations in the “Earthwork” section and the sections below are followed.

7.2 SEISMIC DESIGN CRITERIA

We understand that the project structural design will be based on the 2013 California Building Code (CBC), which provides criteria for the seismic design of buildings in Chapter 16. The “Seismic Coefficients” used to design buildings are established based on a series of tables and figures addressing different site factors, including the soil profile in the upper 100 feet below grade and mapped spectral acceleration parameters based on distance to the controlling seismic source/fault system. Based on our borings and review of local geology, the site is underlain by deep alluvial soils with typical SPT “N” values between 15 and 50 blows per foot. Therefore, we have classified the site as Soil Classification D. The mapped spectral acceleration parameters S_S and S_1 were calculated using the USGS computer program *Seismic Design Maps*, revision date March 12, 2014, based on the site coordinates presented below and the site classification. The table below lists the various factors used to determine the seismic coefficients and other parameters.

Table 3: CBC Site Categorization and Site Coefficients

Classification/Coefficient	Design Value
Site Class	D
Site Latitude	37.36599°
Site Longitude	-122.02550°
0.2-second Period Mapped Spectral Acceleration[1], S_S	1.500g
1-second Period Mapped Spectral Acceleration[1], S_1	0.600g
Short-Period Site Coefficient – Fa	1.0
Long-Period Site Coefficient – Fv	1.5
0.2-second Period, Maximum Considered Earthquake Spectral Response Acceleration Adjusted for Site Effects - S_{MS}	1.500g
1-second Period, Maximum Considered Earthquake Spectral Response Acceleration Adjusted for Site Effects – S_{M1}	0.900g
0.2-second Period, Design Earthquake Spectral Response Acceleration – S_{DS}	1.000g
1-second Period, Design Earthquake Spectral Response Acceleration – S_{D1}	0.600g

[1]For Site Class B, 5 percent damped.

7.3 SHALLOW FOUNDATIONS

7.3.1 Spread Footings

Shear wall footings should bear on natural, undisturbed soil or engineered fill, be at least 18 inches wide, and extend at least 24 inches below the lowest adjacent grade. Lowest adjacent grade is defined as the deeper of the following: 1) bottom of the adjacent interior slab-on-grade, or 2) finished exterior grade, excluding landscaping topsoil.

Footings constructed to the above dimensions and in accordance with the “Earthwork” recommendations of this report are capable of supporting maximum allowable bearing pressures of 2,000 psf for dead loads, 3,000 psf for combined dead plus live loads, and 4,000 psf for all loads including wind and seismic. These pressures are based on factors of safety of 3.0, 2.0, and 1.5 applied to the ultimate bearing pressure for dead, dead plus live, and all loads, respectively. These pressures are net values; the weight of the footing may be neglected for the portion of the footing extending below grade (typically, the full footing depth). The footings should be reinforced as recommended by the project structural engineer.

Based on review from the as-built plans, we estimate the diameter of the belled piers to be 5 feet on average. The belled piers schedule sheet was not included for our review and was not available from the original plan set, therefore, the pier diameter is only an estimate derived by scaling the project plans. We assumed the piers were approximately 12 feet deep, and used a shaft diameter of 18 inches. From these parameters and the soil parameters encountered, we estimate the bearing capacity of the existing footings to be on the order of 6,000 psf.

7.3.2 Footing Settlement

Structural loads were provided to us by Coffman Engineers, the project structural engineer, and specified that the maximum load for the new shear walls would be approximately 110 kips.

Based on our assumed footing layout and the allowable bearing pressures presented above, we estimate that the total static footing settlement for the new shear wall footings will be on the order of less than ½-inch, with about ¼-inch of post-construction differential settlement between adjacent foundation elements. We recommend we be retained to review the final footing layout and loading, and verify the settlement estimates above.

7.3.3 Lateral Loading

Lateral loads may be resisted by friction between the bottom of footing and the supporting subgrade, and also by passive pressures generated against footing sidewalls. An ultimate frictional resistance of 0.40 applied to the footing dead load, and an ultimate passive pressure based on an equivalent fluid pressure of 400 pcf may be used in design. The structural engineer should apply an appropriate factor of safety (such as 1.5) to the ultimate values above. Where footings are adjacent to landscape areas without hardscape, the upper 12 inches of soil should be neglected when determining passive pressure capacity.

7.3.4 Spread Footing Construction Considerations

Where utility lines will cross perpendicular to strip footings, the footing should be deepened to encase the utility line, providing sleeves or flexible cushions to protect the pipes from anticipated foundation settlement, or the utility lines should be backfilled to the bottom of footing with sand-cement slurry or lean concrete. Where utility lines will parallel footings and will extend below the "foundation plane of influence," an imaginary 1:1 plane projected down from the bottom edge of the footing, either the footing will need to be deepened so that the pipe is above the foundation plane of influence or the utility trench will need to be backfilled with sand-cement slurry or lean concrete within the influence zone. Sand-cement slurry used within foundation influence zones should have a minimum compressive strength of 75 psi.

Footing excavations should be filled as soon as possible or be kept moist until concrete placement by regular sprinkling to prevent desiccation. A Cornerstone representative should observe all footing excavations prior to placing reinforcing steel and concrete. If there is a significant schedule delay between our initial observation and concrete placement, we may need to re-observe the excavations.

7.4 HELICAL ANCHORS

We understand that helical anchors may be added to the existing structures to resist seismic uplift loads. Table 4 presents generalized geotechnical parameters that, in our opinion, could be used for the design of vertical, helical ground anchors. The anchors should be designed and installed by a design build contractor who will provide an engineered design for the specified uplift loads for the project. Cornerstone should review the proposed design prior to the start of construction. We recommend the contractor monitor the torque during the anchor installation to verify the anchors have been installed at the required structural capacities. If the capacities of the anchors are greater than 50 kips, we recommend we be retained to provide consultation and observations of contractor testing of the anchors to confirm the capacities. Helical ground anchors should be spaced at a minimum of 3 times the maximum helix diameter. Construction tolerances for vertical alignment should be specified such that there will not be overlap at the anchor tips.

Table 4: Geotechnical Parameters for the Design of Helical Anchors

Depth Below Finished Floor (ft)	Soil Type	Cohesion (psf)	Phi (degrees)	N (blows/ft)	Dry Unit Weight (pcf)
0-3	Neglect	-	-	-	-
3-25	Clay	2,500	0	20	110
25-30	Sand	0	30	35	105

SECTION 8: CONCRETE SLABS

8.1 PARKING STRUCTURE SLAB-ON-GRADE REPLACEMENT

As the existing slab for the parking areas is approximately 5 inches thick and only small portions of the slab will be removed for the construction of the seismic upgrades, we recommend that the slabs be replaced to match the existing section.

SECTION 9: LIMITATIONS

This report, an instrument of professional service, has been prepared for the sole use of Prometheus Real Estate Group specifically to support the design of the Fair Oaks West Apartments project in Sunnyvale, California. The opinions, conclusions, and recommendations presented in this report have been formulated in accordance with accepted geotechnical engineering practices that exist in Northern California at the time this report was prepared. No warranty, expressed or implied, is made or should be inferred.

Recommendations in this report are based upon the soil and ground water conditions encountered during our subsurface exploration. If variations or unsuitable conditions are encountered during construction, Cornerstone must be contacted to provide supplemental recommendations, as needed.

Prometheus Real Estate Group may have provided Cornerstone with plans, reports and other documents prepared by others. Prometheus Real Estate Group understands that Cornerstone reviewed and relied on the information presented in these documents and cannot be responsible for their accuracy.

Cornerstone prepared this report with the understanding that it is the responsibility of the owner or his representatives to see that the recommendations contained in this report are presented to other members of the design team and incorporated into the project plans and specifications, and that appropriate actions are taken to implement the geotechnical recommendations during construction.

Conclusions and recommendations presented in this report are valid as of the present time for the development as currently planned. Changes in the condition of the property or adjacent properties may occur with the passage of time, whether by natural processes or the acts of other persons. In addition, changes in applicable or appropriate standards may occur through legislation or the broadening of knowledge. Therefore, the conclusions and recommendations presented in this report may be invalidated, wholly or in part, by changes beyond Cornerstone's control. This report should be reviewed by Cornerstone after a period of three (3) years has elapsed from the date of this report. In addition, if the current project design is changed, then Cornerstone must review the proposed changes and provide supplemental recommendations, as needed.

An electronic transmission of this report may also have been issued. While Cornerstone has taken precautions to produce a complete and secure electronic transmission, please check the electronic transmission against the hard copy version for conformity.

Recommendations provided in this report are based on the assumption that Cornerstone will be retained to provide observation and testing services during construction to confirm that conditions are similar to that assumed for design, and to form an opinion as to whether the work has been performed in accordance with the project plans and specifications. If we are not retained for these services, Cornerstone cannot assume any responsibility for any potential claims that may arise during or after construction as a result of misuse or misinterpretation of Cornerstone's report by others. Furthermore, Cornerstone will cease to be the Geotechnical-Engineer-of-Record if we are not retained for these services.

SECTION 10: REFERENCES

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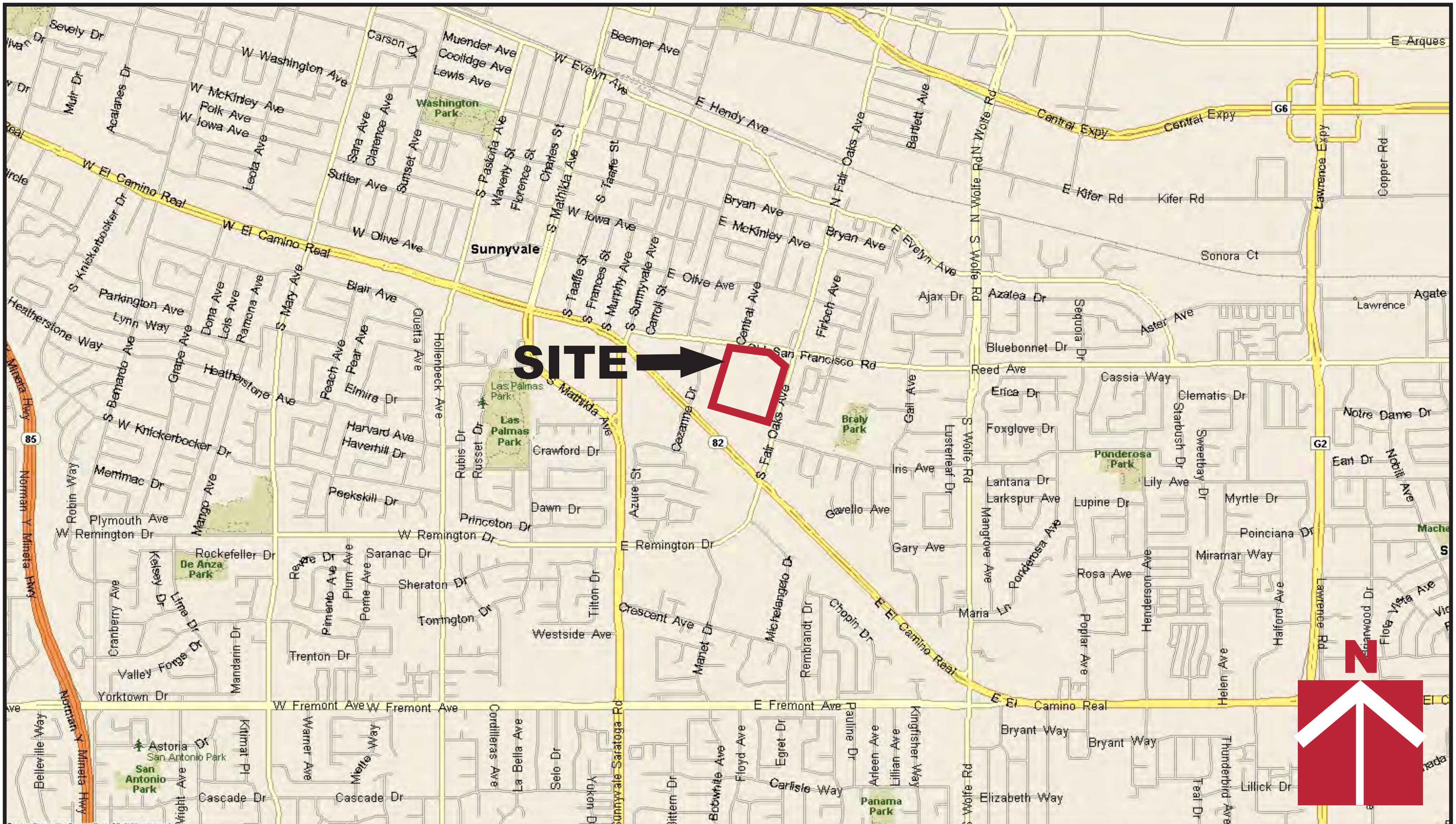


CORNERSTONE
EARTH GROUP

Vicinity Map

Fair Oaks West Apartments
Sunnyvale, CA

Project Number	307-10-1
Figure Number	Figure 1
Date	July 2014
Drawn By	RRN

Legend

Approximate location of exploratory boring (EB)

0 150 300

APPROXIMATE SCALE (FEET)

Base by Google Earth, dated 2/23/2014

Project Number 307-10-1

Figure Number Figure 2

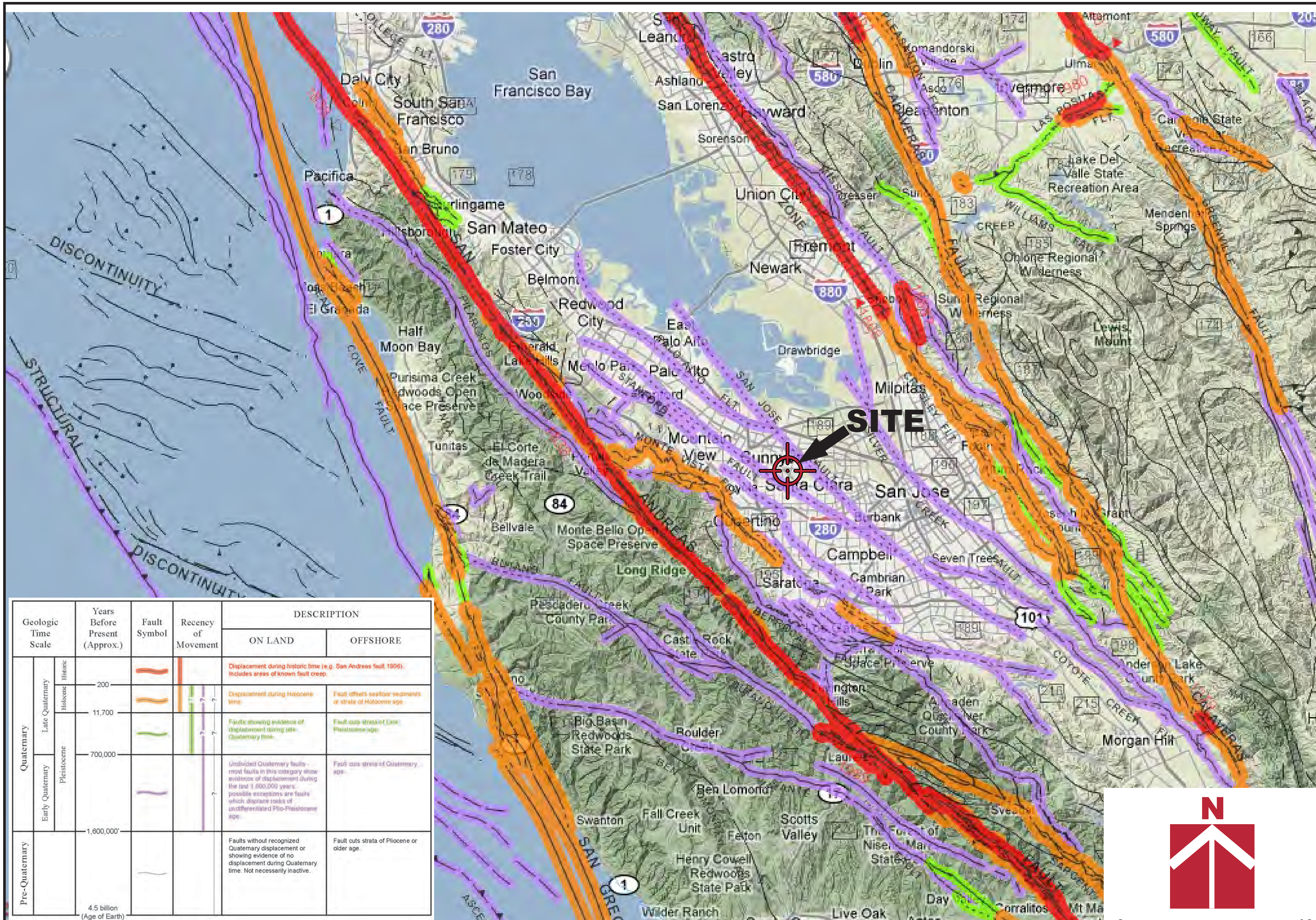
Date July 2014

Drawn By RRN

Site Plan

Fair Oaks West Apartments
Sunnyvale, CA

CORNERSTONE EARTH GROUP



Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic				Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
			200				
		Holocene				Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
			11,700				
		Pleistocene				Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
			700,000				
	Early Quaternary					Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
			1,600,000*				
Pre-Quaternary						Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.
			4.5 billion (Age of Earth)				

Base by California Geological Survey - 2010 Fault Activity Map of California (Jennings and Bryant, 2010)

N

0 5 10

APPROXIMATE SCALE (MILES)

Project Number 307-10-1

Figure Number Figure 3

Date July 2014

Drawn By RRN

Regional Fault Map

Fair Oaks West Apartments
Sunnyvale, CA

CORNERSTONE EARTH GROUP

APPENDIX A: FIELD INVESTIGATION

The field investigation consisted of a surface reconnaissance and a subsurface exploration program using truck-mounted hollow-stem auger and limited-access drilling equipment. Seven (7) 8-inch-diameter exploratory borings using truck mounted equipment were drilled on June 23 and 24, 2014 to depths of 6 to 40 feet, while three (3) 4-inch-diameter borings were drilled with solid stem auger "minuteman" drilling equipment. The approximate locations of exploratory borings are shown on the Site Plan, Figure 2. The soils encountered were continuously logged in the field by our representative and described in accordance with the Unified Soil Classification System (ASTM D2488). Boring logs, as well as a key to the classification of the soil and bedrock, are included as part of this appendix.

Boring locations were approximated using existing site boundaries and other site features as references. Boring elevations were not determined. The locations of the borings should be considered accurate only to the degree implied by the method used.

Representative soil samples were obtained from the borings at selected depths. All samples were returned to our laboratory for evaluation and appropriate testing. The standard penetration resistance blow counts were obtained by dropping a 140-pound hammer through a 30-inch free fall, unless otherwise noted as for the borings located below the buildings. Due to the low clearance and overhead limit of the first story under the buildings, the first sample in borings EB-6, EB-9 and EB-10 was taken from less than 30-inches free fall. All other samples used a 30-inch free fall during sampling. As noted on these boring logs, a 70-pound hammer was used in every sampling drive, again due to the overhead clearance limit. The 2-inch O.D. split-spoon sampler was driven 18 inches and the number of blows was recorded for each 6 inches of penetration (ASTM D1586). 2.5-inch I.D. samples were obtained using a Modified California Sampler driven into the soil with the 140-pound hammer previously described. Unless otherwise indicated, the blows per foot recorded on the boring log represent the accumulated number of blows required to drive the last 12 inches. The various samplers are denoted at the appropriate depth on the boring logs.

Field tests included an evaluation of the unconfined compressive strength of the soil samples using a pocket penetrometer device. The results of these tests are presented on the individual boring logs at the appropriate sample depths.

Attached boring logs and related information depict subsurface conditions at the locations indicated and on the date designated on the logs. Subsurface conditions at other locations may differ from conditions occurring at these boring locations. The passage of time may result in altered subsurface conditions due to environmental changes. In addition, any stratification lines on the logs represent the approximate boundary between soil types and the transition may be gradual.

BORING NUMBER EB-1

CORNERSTONE EARTH GROUP

PROJECT NAME Fair Oaks West Apartments
PROJECT NUMBER 307-10-1
PROJECT LOCATION Sunnyvale, CA
DATE STARTED 6/23/14 **DATE COMPLETED** 6/23/14
GROUND ELEVATION **BORING DEPTH** 30 ft.
DRILLING CONTRACTOR Exploration Geoservices, Inc.
LATITUDE 37.367282º **LONGITUDE** -122.024359º
DRILLING METHOD Mobile B-53, 8 inch Hollow-Stem Auger
GROUND WATER LEVELS:
LOGGED BY CSH
▽ **AT TIME OF DRILLING** Not Encountered
NOTES
▼ **AT END OF DRILLING** Not Encountered

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DESCRIPTION

DEPTH (ft)	DESCRIPTION
0	3 inches asphalt concrete over 3 inches aggregate base
	Sandy Lean Clay (CL) hard, moist, dark brown to brown, fine to medium sand, some fine subangular to subrounded gravel, low plasticity
5	**Clayey Sand (SC)** medium dense, moist, brown, fine to medium sand, some fine subangular to subrounded gravel
	Lean Clay with Sand (CL) hard, moist, brown, fine to medium sand, moderate plasticity
	Clayey Sand (SC) medium dense, moist, brown with reddish brown mottles, fine to medium sand
	Lean Clay with Sand (CL) very stiff, moist, gray with brown mottles, fine sand, low to moderate plasticity
25	**Clayey Sand (SC)** medium dense, moist, gray with brown mottles, fine to medium sand, some fine gravel
	Sandy Lean Clay (CL) very stiff, moist, gray with brown mottles, fine to medium sand, low to moderate plasticity
30	Bottom of Boring at 30.0 feet.

N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf (○ HAND PENETROMETER; △ TORVANE; ● UNCONFINED COMPRESSION; ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL)
30	MC-2	106	16			○ >4.5
25	MC-4	111	12			○ >4.5
17	MC-6	103	10		40	
27	MC-8	105	15			○ >4.5
41	MC-10	110	18			○ >4.5
25	MC-12	110	17			○
48	MC-14	114	16			
21	SPT-15		23			○

BORING NUMBER EB-2

CORNERSTONE EARTH GROUP

PROJECT NAME Fair Oaks West Apartments
PROJECT NUMBER 307-10-1
PROJECT LOCATION Sunnyvale, CA

DATE STARTED 6/23/14 DATE COMPLETED 6/23/14
DRILLING CONTRACTOR Exploration Geoservices, Inc.
DRILLING METHOD Mobile B-53, 8 inch Hollow-Stem Auger
LOGGED BY CSH
NOTES

GROUND ELEVATION
BORING DEPTH 29.4 ft.
LATITUDE 37.367465°
LONGITUDE -122.025907°
GROUND WATER LEVELS:
AT TIME OF DRILLING Not Encountered
AT END OF DRILLING Not Encountered

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UNDRAINED SHEAR STRENGTH, ksf: ○ HAND PENETROMETER; △ TORVANE; ● UNCONFINED COMPRESSION; ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL (scale 1.0, 2.0, 3.0, 4.0)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf
	0	3½ inches asphalt concrete over 3 inches aggregate base							
		Lean Clay with Sand (CL) hard, moist, dark brown to brown, fine to medium sand, low plasticity	27	MC-1	100	16			>4.5
		Sandy Lean Clay (CL) hard, moist, brown, fine to medium sand, some fine subangular to subrounded gravel, low plasticity	18	MC-3	104	13			>4.5
	5		22	MC-5	117	9		52	>4.5
		Lean Clay (CL) hard, moist, brown, some fine sand, moderate plasticity	43	MC-7	115	14			>4.5
	10		40	MC-9	115	14			>4.5
		Lean Clay with Sand (CL) hard, moist, brown, fine to medium sand, moderate plasticity	57	MC-10	106	13			>4.5
	15								
		Clayey Sand (SC) medium dense, moist, brown, fine to coarse sand, some fine subangular to subrounded gravel	42	MC-12	111	14			
	20								
		Lean Clay with Sand (CL) hard, moist, gray with brown mottles, fine to medium sand, moderate plasticity	41	SPT-13		11			>4.5
	25								
		Sandy Lean Clay (CL) hard, moist, gray with brown mottles, fine to medium sand, low plasticity	50/5"	SPT					>4.5
		Bottom of Boring at 29.4 feet.							
	30								

CORNERSTONE EARTH GROUP

PROJECT NAME Fair Oaks West Apartments
PROJECT NUMBER 307-10-1
PROJECT LOCATION Sunnyvale, CA

DATE STARTED 6/23/14 **DATE COMPLETED** 6/23/14
GROUND ELEVATION **BORING DEPTH** 35 ft.
DRILLING CONTRACTOR Exploration Geoservices, Inc.
LATITUDE 37.366818° **LONGITUDE** -122.026604°
DRILLING METHOD Mobile B-53, 8 inch Hollow-Stem Auger
GROUND WATER LEVELS:
LOGGED BY CSH
▽ **AT TIME OF DRILLING** Not Encountered
NOTES
▼ **AT END OF DRILLING** Not Encountered

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UNDRAINED SHEAR STRENGTH, ksf: ○ HAND PENETROMETER; △ TORVANE; ● UNCONFINED COMPRESSION; ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL (scale 1.0, 2.0, 3.0, 4.0)

DEPTH (ft)	DESCRIPTION
0	4 inches asphalt concrete over 3 inches aggregate base
	Sandy Lean Clay (CL) hard, moist, brown, fine to medium sand, low plasticity
	Clayey Sand (SC) medium dense, moist, brown, fine to medium sand, some fine subangular to subrounded gravel
	Lean Clay with Sand (CL) very stiff, moist, brown, fine to medium sand, moderate plasticity
	Clayey Sand (SC) dense, moist, brown, fine to medium sand, some fine subangular to subrounded gravel
	Sandy Lean Clay (CL) stiff, moist, brown, fine to medium sand, low plasticity
	Poorly Graded Sand with Silt and Gravel (SP-SM) very dense, moist, gray with brown and orange mottles, fine to coarse sand, fine to coarse subangular to subrounded gravel

N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf
20	MC-2	103	15			>4.5 ○
23	MC-4	109	8		44	
17	MC-6	95	10			
39	MC-7	99	17			>4.5 ○
51	MC-9	110	13			>4.5 ○
67	MC-11	107	10			
						○
50 6"	MC					
50 5"	MC					

Continued Next Page

CORNERSTONE EARTH GROUP

PROJECT NAME Fair Oaks West Apartments
PROJECT NUMBER 307-10-1
PROJECT LOCATION Sunnyvale, CA

UNDRAINED SHEAR STRENGTH, ksf: ○ HAND PENETROMETER; △ TORVANE; ● UNCONFINED COMPRESSION; ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL (scale 1.0, 2.0, 3.0, 4.0)

ELEVATION (ft)	DEPTH (ft)	SYMBOL	DESCRIPTION	N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf
			Clayey Sand with Gravel (SC) very dense, moist, gray with brown mottles, fine to coarse sand, fine to coarse subangular to subrounded gravel	50/6"	MC					
	30									
			Lean Clay (CL) stiff, moist, olive brown with gray mottles, some fine sand, moderate plasticity	15	SPT					○ (~1.8, hand penetrometer)
	35		Bottom of Boring at 35.0 feet.							
	40									
	45									
	50									
	55									

BORING NUMBER EB-4

CORNERSTONE EARTH GROUP

PROJECT NAME Fair Oaks West Apartments
PROJECT NUMBER 307-10-1
PROJECT LOCATION Sunnyvale, CA
DATE STARTED 6/23/14 **DATE COMPLETED** 6/23/14
GROUND ELEVATION **BORING DEPTH** 30 ft.
DRILLING CONTRACTOR Exploration Geoservices, Inc.
LATITUDE 37.366031° **LONGITUDE** -122.025538°
DRILLING METHOD Mobile B-53, 8 inch Hollow-Stem Auger
GROUND WATER LEVELS:
LOGGED BY CSH
▽ **AT TIME OF DRILLING** Not Encountered
NOTES
▼ **AT END OF DRILLING** Not Encountered

This log is a part of a report by Cornerstone Earth Group, and should not be used as a stand-alone document. This description applies only to the location of the exploration at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with time. The description presented is a simplification of actual conditions encountered. Transitions between soil types may be gradual.

Undrained shear strength, ksf legend: ○ HAND PENETROMETER; △ TORVANE; ● UNCONFINED COMPRESSION; ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL (scale 1.0, 2.0, 3.0, 4.0)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf
	0	4 inches asphalt concrete over 3 inches aggregate base							
		Sandy Lean Clay (CL) hard, moist, dark brown to brown, fine to medium sand, low plasticity	21	MC-1	107	13			>4.5 ○
			14	MC-3	104	11		50	>4.5 ○
	5	**Clayey Sand (SC)** medium dense, moist, brown, fine to coarse sand, some fine subangular to subrounded gravel	19	MC-5	107	9			
		Lean Clay with Sand (CL) hard, moist, brown, fine to medium sand, low to moderate plasticity	24	MC-7	119	12			>4.5 ○
	10								
		Poorly Graded Sand with Clay and Gravel (SP-SC) medium dense, moist, gray and brown, fine to coarse sand, fine to coarse subangular to subrounded gravel	29	MC-9	121	4			
	15								
		Clayey Sand with Gravel (SC) medium dense, moist, brown, fine to medium sand, some fine subangular to subrounded gravel	15	SPT-10		12			
	20								
		Poorly Graded Sand with Silt and Gravel (SP-SM) very dense, moist, brown, fine to medium sand, some fine subangular to subrounded gravel	60	SPT-11		3			
	25								
		becomes dense	33	SPT					
	30	Bottom of Boring at 30.0 feet.							

BORING NUMBER EB-5

CORNERSTONE EARTH GROUP

PROJECT NAME Fair Oaks West Apartments
PROJECT NUMBER 307-10-1
PROJECT LOCATION Sunnyvale, CA

DATE STARTED 6/24/14 **DATE COMPLETED** 6/24/14
GROUND ELEVATION **BORING DEPTH** 30 ft.
DRILLING CONTRACTOR Exploration Geoservices, Inc.
LATITUDE 37.365469° **LONGITUDE** -122.027038°
DRILLING METHOD Mobile B-53, 8 inch Hollow-Stem Auger
GROUND WATER LEVELS:
LOGGED BY RSM
∇ **AT TIME OF DRILLING** Not Encountered
NOTES
▼ **AT END OF DRILLING** Not Encountered

This log is a part of a report by Cornerstone Earth Group, and should not be used as a stand-alone document. This description applies only to the location of the exploration at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with time. The description presented is a simplification of actual conditions encountered. Transitions between soil types may be gradual.

UNDRAINED SHEAR STRENGTH, ksf: ○ HAND PENETROMETER; △ TORVANE; ● UNCONFINED COMPRESSION; ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL (scale 1.0, 2.0, 3.0, 4.0)

DEPTH (ft)	DESCRIPTION	N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf
0	1 inches asphalt concrete over 5 inches aggregate base							
	Sandy Lean Clay (CL) hard, dry to moist, brown, fine to coarse sand, some fine subangular to subrounded gravel, low plasticity Liquid Limit =28, Plastic Limit =14	52	MC-1B	111	8	14		>4.5 ○
		55	MC-2B	111	7			>4.5 ○
5		39	MC-3B	114	8			>4.5 ○
	Lean Clay with Sand (CL) hard, moist, brown, fine to medium sand, low to moderate plasticity	50	MC-4B	119	10			
10	**Poorly Graded Sand with Silt and Gravel (SP-SM)** very dense, moist, brown to light brown, fine to medium sand, some fine subangular to subrounded gravel	50/5"	MC-5B	119	3			
15		50/5"	SPT-6		2		11	
20		50/5"	SPT-7		2			
25	color changes to gray brown	64	SPT-8		3			
30		71	SPT					
	Bottom of Boring at 30.0 feet.							

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BORING NUMBER EB-6

CORNERSTONE EARTH GROUP

PROJECT NAME Fair Oaks West Apartments
PROJECT NUMBER 307-10-1
PROJECT LOCATION Sunnyvale, CA

DATE STARTED 6/23/14 **DATE COMPLETED** 6/23/14
DRILLING CONTRACTOR Access Soil Drilling, Inc.
DRILLING METHOD Minuteman, 4 inch Solid Flight Auger
LOGGED BY PKM
NOTES Hammer not dropped full 30" for sample No.1. 70lb hammer

GROUND ELEVATION **BORING DEPTH** 10 ft.
LATITUDE 37.366007° **LONGITUDE** -122.026693°
GROUND WATER LEVELS:
AT TIME OF DRILLING Not Encountered
AT END OF DRILLING Not Encountered

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UNDRAINED SHEAR STRENGTH, ksf: ○ HAND PENETROMETER; △ TORVANE; ● UNCONFINED COMPRESSION; ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL (scale 1.0, 2.0, 3.0, 4.0)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf
	0	5½ inches Portland cement concrete over 1½ inches aggregate base							
		Lean Clay with Sand (CL) [Fill] hard, moist, brown, fine to coarse sand, fine to coarse subrounded gravel, low to moderate plasticity	91	MC-1B	109	10			>4.5 ○
		Sandy Lean Clay (CL) [Fill] hard, moist, brown, fine to coarse sand, some fine to coarse subrounded gravel, low plasticity	70	MC-2B	110	8			>4.5 ○
	5	**Sandy Lean Clay (CL)** hard, moist, brown, fine to medium sand, low plasticity	107	MC-3B	97	13			>4.5 ○
			96	MC-4B	113	15			>4.5 ○
	10	**Lean Clay with Sand (CL)** hard, moist, brown, fine to coarse sand, some fine subrounded gravel, moderate plasticity							
		Sampling performed with 70lb hammer. Bottom of Boring at 10.0 feet.							
	15								
	20								

BORING NUMBER EB-7

CORNERSTONE EARTH GROUP

PROJECT NAME Fair Oaks West Apartments
PROJECT NUMBER 307-10-1
PROJECT LOCATION Sunnyvale, CA

DATE STARTED 6/24/14 **DATE COMPLETED** 6/24/14
DRILLING CONTRACTOR Exploration Geoservices, Inc.
DRILLING METHOD Mobile B-53, 8 inch Hollow-Stem Auger
LOGGED BY RSM
NOTES

GROUND ELEVATION **BORING DEPTH** 6.5 ft.
LATITUDE 37.364494° **LONGITUDE** -122.024525°
GROUND WATER LEVELS:
AT TIME OF DRILLING Not Encountered
AT END OF DRILLING Not Encountered

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UNDRAINED SHEAR STRENGTH, ksf: ○ HAND PENETROMETER; △ TORVANE; ● UNCONFINED COMPRESSION; ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL (scale 1.0, 2.0, 3.0, 4.0)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf
	0	5½ inches asphalt concrete over 4½ inches aggregate base							
		Sandy Lean Clay (CL) [Fill] hard, moist, brown with light brown mottles, fine to coarse sand, low plasticity	31	MC-1	111	12			
			11	MC-2B	106	10			
	5		19	MC-3B	107	11			
		Encountered utility pipe and terminated boring.							
		Bottom of Boring at 6.5 feet.							
	10								
	15								
	20								

CORNERSTONE EARTH GROUP

PROJECT NAME Fair Oaks West Apartments
PROJECT NUMBER 307-10-1
PROJECT LOCATION Sunnyvale, CA

DATE STARTED 6/24/14 **DATE COMPLETED** 6/24/14
GROUND ELEVATION **BORING DEPTH** 40 ft.
DRILLING CONTRACTOR Exploration Geoservices, Inc.
LATITUDE 37.365836° **LONGITUDE** -122.023877°
DRILLING METHOD Mobile B-53, 8 inch Hollow-Stem Auger
GROUND WATER LEVELS:
LOGGED BY RSM
∇ **AT TIME OF DRILLING** 39 ft.
NOTES
▼ **AT END OF DRILLING** 39 ft.

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UNDRAINED SHEAR STRENGTH, ksf: ○ HAND PENETROMETER; △ TORVANE; ● UNCONFINED COMPRESSION; ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL (scale 1.0, 2.0, 3.0, 4.0)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf
	0	2½ inches asphalt concrete over 6½ aggregate base							
		Sandy Lean Clay (CL) hard, moist, brown, fine to medium sand, some fine subangular to subrounded gravel, low plasticity	38	MC-1B	119	12			>4.5 ○
			33	MC-2	110	11			>4.5 ○
	5		34	MC-3	115	10			>4.5 ○
		Lean Clay (CL) hard, moist, brown, some fine sand, moderate plasticity	57	MC-4B	120	13			>4.5 ○
	10	**Lean Clay with Sand (CL)** hard, moist, light brown, fine sand, moderate plasticity	53	MC-5B	99	12		82	>4.5 ○
		Sandy Lean Clay (CL) hard, moist, light brown, fine to medium sand, low plasticity	25	SPT-6		9			>4.5 ○
	15								
		Clayey Sand (SC) medium dense, moist, light brown, fine to coarse sand, some fine subangular to subrounded gravel	54	SPT-7		5			
	20								
		Sandy Lean Clay (CL) hard, moist, gray and brown mottled, fine to medium sand, some fine subangular to subrounded gravel, low plasticity	55	SPT-9		11			>4.5 ○
	25								
	30		65	SPT-10					>4.5 ○

Continued Next Page

BORING NUMBER EB-8

CORNERSTONE EARTH GROUP

PROJECT NAME Fair Oaks West Apartments

PROJECT NUMBER 307-10-1

PROJECT LOCATION Sunnyvale, CA

This log is a part of a report by Cornerstone Earth Group, and should not be used as a stand-alone document. This description applies only to the location of the exploration at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with time. The description presented is a simplification of actual conditions encountered. Transitions between soil types may be gradual.

ELEVATION (ft)	DEPTH (ft)	SYMBOL	DESCRIPTION	N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf
			Poorly Graded Sand with Silt and Gravel (SP-SM) medium dense, moist, brown, fine to medium sand, some fine subangular to subrounded gravel	33	SPT-11B		9			
	35		**Clayey Sand (SC)** medium dense, moist, brown, fine to coarse sand, some fine subangular to subrounded gravel	28	MC-12A	108	19			○ 1.5 (hand penetrometer)
	40		**Sandy Lean Clay (CL)** stiff, moist, brown, fine to medium sand, low plasticity							
			Bottom of Boring at 40.0 feet.							
	45									
	50									
	55									
	60									
	65									

UNDRAINED SHEAR STRENGTH, ksf legend: ○ HAND PENETROMETER; △ TORVANE; ● UNCONFINED COMPRESSION; ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL. Scale: 1.0, 2.0, 3.0, 4.0

BORING NUMBER EB-9

CORNERSTONE EARTH GROUP

PROJECT NAME Fair Oaks West Apartments

PROJECT NUMBER 307-10-1

PROJECT LOCATION Sunnyvale, CA

DATE STARTED 6/23/14 **DATE COMPLETED** 6/23/14

GROUND ELEVATION **BORING DEPTH** 10 ft.

DRILLING CONTRACTOR Access Soil Drilling, Inc.

LATITUDE 37.367204° **LONGITUDE** -122.025847°

DRILLING METHOD Minuteman, 4 inch Solid Flight Auger

GROUND WATER LEVELS:

LOGGED BY PKM

AT TIME OF DRILLING Not Encountered

NOTES Hammer not dropped full 30" for sample Number 1. 70lb hammer

AT END OF DRILLING Not Encountered

This log is a part of a report by Cornerstone Earth Group, and should not be used as a stand-alone document. This description applies only to the location of the exploration at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with time. The description presented is a simplification of actual conditions encountered. Transitions between soil types may be gradual.

UNDRAINED SHEAR STRENGTH, ksf: ○ HAND PENETROMETER; △ TORVANE; ● UNCONFINED COMPRESSION; ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL (scale 1.0, 2.0, 3.0, 4.0)

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf
	0	5½ inches Portland cement concrete over 1½ inches aggregate base							
		Sandy Lean Clay (CL) hard, moist, brown, fine to medium sand, low plasticity; Liquid Limit = 30, Plastic Limit = 14	75	MC-1B	114	12	16		>4.5 ○
			51	MC-2B	110	10			>4.5 ○
	5	**Lean Clay with Sand (CL)** hard, moist, brown, fine to medium sand, low to moderate plasticity	110	MC-3B	114	14			>4.5 ○
			100	MC-4B	96	15			>4.5 ○
	10	Sampling performed with 70lb hammer. Bottom of Boring at 10.0 feet.							
	15								
	20								

BORING NUMBER EB-10

CORNERSTONE EARTH GROUP

PROJECT NAME Fair Oaks West Apartments
PROJECT NUMBER 307-10-1
PROJECT LOCATION Sunnyvale, CA

DATE STARTED 6/23/14 DATE COMPLETED 6/23/14
GROUND ELEVATION BORING DEPTH 10.5 ft.
DRILLING CONTRACTOR Access Soil Drilling, Inc.
LATITUDE 37.366479° LONGITUDE -122.026549°
DRILLING METHOD Minuteman, 4 inch Solid Flight Auger
GROUND WATER LEVELS:
LOGGED BY PKM
AT TIME OF DRILLING Not Encountered
NOTES Hammer not dropped full 30" for sample No.1. 70lb hammer
AT END OF DRILLING Not Encountered

This log is a part of a report by Cornerstone Earth Group, and should not be used as a stand-alone document. This description applies only to the location of the exploration at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with time. The description presented is a simplification of actual conditions encountered. Transitions between soil types may be gradual.

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf (○ HAND PENETROMETER, △ TORVANE, ● UNCONFINED COMPRESSION, ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL; 1.0 2.0 3.0 4.0)
	0	5½ inches Portland cement concrete over 1½ inches aggregate base							
		Sandy Lean Clay (CL) [Fill] hard, moist, brown with light brown mottles, fine to coarse sand, low plasticity	133	MC-1B	106	10			>4.5
		Sandy Lean Clay (CL) hard, moist, brown, fine to medium sand, some fine suangular to subrounded gravel, low plasticity	118	MC-2B	106	8			>4.5
	5		70/5"	MC-3B	106	10			>4.5
			70/6"	MC					>4.5
	10	**Lean Clay with Sand (CL)** hard, moist, brown, fine to coarse sand, moderate plasticity	109	SPT-5		11			>4.5
		Sampling performed with 70lb hammer. Bottom of Boring at 10.5 feet.							
	15								
	20								

CORNERSTONE EARTH GROUP2 - CORNERSTONE 0812.GDT - 7/25/14 10:09 - P:\DRAFTING\GINT FILES\307-10-1 FAIR OAKS WEST.GPJ

APPENDIX B: LABORATORY TEST PROGRAM

The laboratory testing program was performed to evaluate the physical and mechanical properties of the soils retrieved from the site to aid in verifying soil classification.

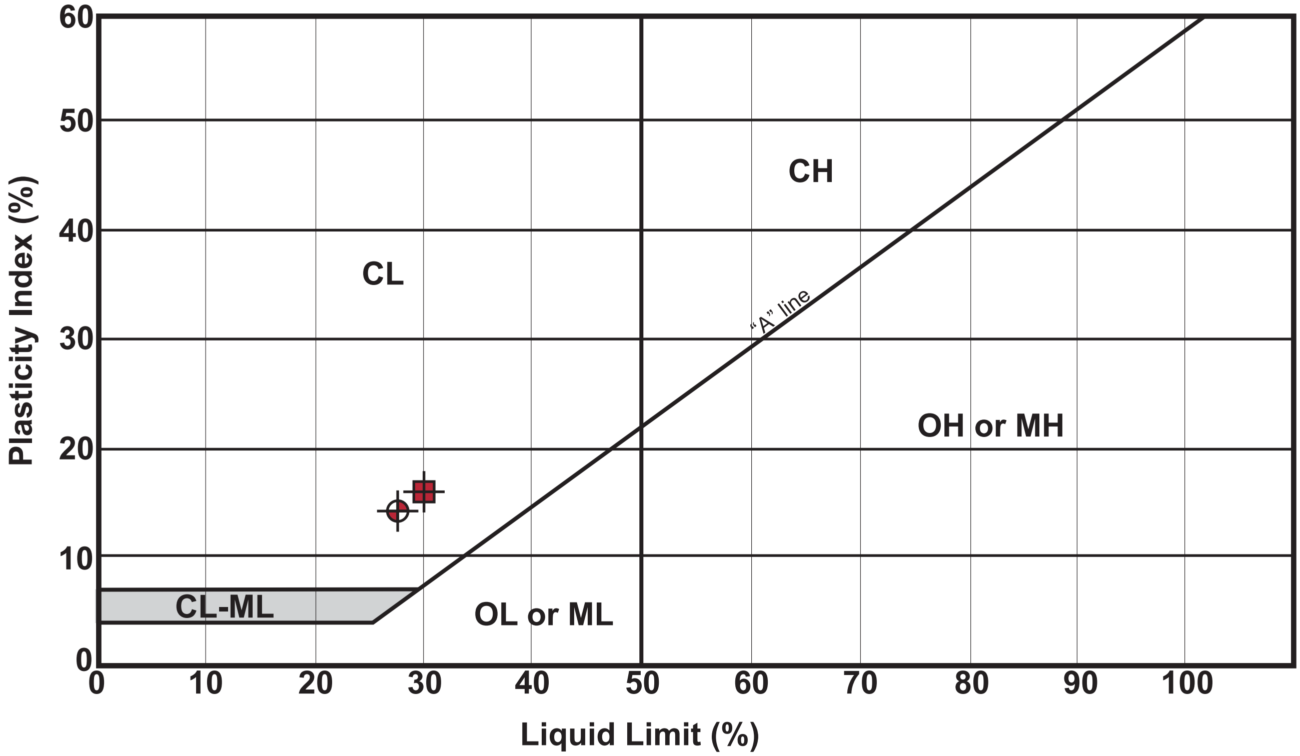
Moisture Content: The natural water content was determined (ASTM D2216) on sixty-one (61) samples of the materials recovered from the borings. These water contents are recorded on the boring logs at the appropriate sample depths.

Dry Densities: In place dry density determinations (ASTM D2937) were performed on fifty (50) samples to measure the unit weight of the subsurface soils. Results of these tests are shown on the boring logs at the appropriate sample depths.

Washed Sieve Analyses: The percent soil fraction passing the No. 200 sieve (ASTM D1140) was determined on six (6) samples of the subsurface soils to aid in the classification of these soils. Results of these tests are shown on the boring logs at the appropriate sample depths.

Plasticity Index: Two Plasticity Index determinations (ASTM D4318) were performed on samples of the subsurface soils to measure the range of water contents over which this material exhibits plasticity. The Plasticity Index was used to classify the soil in accordance with the Unified Soil Classification System and to evaluate the soil expansion potential. Results of these tests are shown on the boring logs at the appropriate sample depths.

Plasticity Index (ASTM D4318) Testing Summary



Symbol	Boring No.	Depth (ft)	Natural Water Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Passing No. 200 (%)	Group Name (USCS - ASTM D2487)
⊕	EB-5	2.0	8	28	14	14	—	Sandy Lean Clay (CL)
■	EB-9	2.0	12	30	14	16	—	Sandy Lean Clay (CL)

CORNERSTONE EARTH GROUP

Plasticity Index Testing Summary

Fair Oaks West Apartments
Sunnyvale, CA

Project Number 307-10-1

Figure Number Figure B1

Date July 2014

Drawn By FLL