Appendix D

Geotechnical Soils Report

ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Suite B
Escondido, California 92029
Telephone: (619) 867-0487 Fax: (714) 409-3287

Steven Walker Communities
4590 MacArthur Boulevard, Suite 600
Newport Beach, California 92660

June 9, 2022
P/W 2101-06
Report No. 2101-06-B-4
County Geologic Report No. 220013

Attention: **Mr. Steve Berzansky**

Subject: ***Response to County of Riverside Geology Review Comments, Tentative Tract Map 37743, Highgrove Area, County of Riverside, California***

References: See Appendix

Gentlepersons,

Advanced Geotechnical Solutions, Inc., (AGS) has prepared this letter presenting our response to Riverside County Planning Department comments dated June 8, 2022, in regard to Tentative Tract Map 37743 in Highgrove, County of Riverside, California. The related review comments precede AGS's response.

Comment 1 – Please clarify the criteria for establishing suitability of soil and/or rock to be left-in-place (removal bottoms), which should be demonstrated using appropriate qualitative and/or quantitative assessments. Qualitative assessments could include criteria such as removing unsuitable soils to expose bedrock, while quantitative assessments could include criteria based on such physical properties as unit weight, degree of saturation, in-situ relative compaction, or hydrocollapse analysis results. These assessments should be tied to site-specific data gathered from the subsurface investigation program and will ultimately form the basis for determining removal depths during construction. Simply using terms such as "competent", "dense", "hard", "unyielding", "suitable", or "undisturbed" without supporting quantitative and/or qualitative data is not sufficient.

AGS Response: The upper topsoil and undocumented fill should be completely removed prior to placement of fill materials. Additionally, the upper weathered/porous old alluvial fan deposits should be removed. Old alluvial fan deposits that exhibit an in-situ relative compaction of at least 90 percent may be left in place. Density testing should be conducted during grading to evaluate the density of the old alluvial fan deposits exposed at the removal bottom. A lesser relative compaction can be considered if the exposed deposits exposed are found, based on additional consolidation testing, to be subject to potential hydroconsolidation of 1 percent or less.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to contact the undersigned.

Respectfully Submitted,
Advanced Geotechnical Solutions, Inc.

JOHN J. DONOVAN, Geotechnical Engineer
RCE 65051, RGE 2790, Reg. Exp. 6-30-23

PAUL DERISI, Engineering Geologist
CEG 2536, Reg. Exp. 5-31-23

REGISTERED PROFESSIONAL ENGINEER JOHN J. DONOVAN GE 2790 GEOTECHNICAL STATE OF CALIFORNIA

PROFESSIONAL GEOLOGIST PAUL J. DERISI No. 2536 CERTIFIED ENGINEERING GEOLOGIST STATE OF CALIFORNIA

2101-06-B-4 (Jun 9, 2022, Reponse to Geo Review, TTM 37743, Highgrove).docx

Distribution: (1) Addressee (pdf)

APPENDIX
REFERENCES

Advanced Geotechnical Solutions, Inc. (2021). “Updated Geotechnical Evaluation and Review of Conceptual Grading Plans, Tentative Tract 37743, Highgrove Area, County of Riverside, California,” Report No. 2101-06-B-2, January 22, 2021.

---. (2022). “Updated Geotechnical Report, Tentative Tract Map 37743, Highgrove Area, County of Riverside, California,” Report No. 2101-06-B-3, March 1, 2022.

Woodard Group. (2021). Overall Plot Plan, Parcels 1, 2, &3 Tentative Tract Map 37743, date August 2021, Sheets 1 and 2 of 2.

ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Suite B
Escondido, California 92029
Telephone: (619) 867-0487 Fax: (714) 409-3287

Steven Walker Communities
4590 MacArthur Boulevard, Suite 600
Newport Beach, California 92660

March 1, 2022
P/W 2101-06
Report No. 2101-06-B-3

Attention: **Mr. Steve Berzansky**

Subject: ***Updated Geotechnical Report, Tentative Tract Map 37743, Highgrove Area, County of Riverside, California***

References: Advanced Geotechnical Solutions, Inc. (2021). "Updated Geotechnical Evaluation and Review of Conceptual Grading Plans, Tentative Tract 37743, Highgrove Area, County of Riverside, California," Report No. 2101-06-B-2, January 22, 2021.

Woodard Group. (2021). *Overall Plot Plan, Parcels 1, 2, &3 Tentative Tract Map 37743*, date August 2021, Sheets 1 and 2 of 2.

Gentlepersons,

Advanced Geotechnical Solutions, Inc., (AGS) has prepared this updated report presenting our review of the recent Tentative Tract Map 37743, located northeast of Center Street and Mount Vernon Avenue in the Highgrove Area, County of Riverside, California. AGS previously prepared the referenced geotechnical report for the site in 2021. AGS has reviewed the referenced TTM prepared by the Woodward Group. The reviewed plan is largely the same as the plan addressed in our referenced 2021 geotechnical report. The limits of the bioretention basin changed slightly, but the remainder of the plan was largely the same as previously reviewed. The recommendations provided in the 2021 report conform with the currently adopted 2019 California Building Code. Accordingly the recommendations provided in the referenced report are still considered applicable to the TTM, and updated recommendations are not needed at this time.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to contact the undersigned.

Respectfully Submitted,
Advanced Geotechnical Solutions, Inc.

JOHN J. DONOVAN, Geotechnical Engineer
RCE 65051, RGE 2790, Reg. Exp. 6-30-23

PAUL DERISI, Engineering Geologist
CEG 2536, Reg. Exp. 5-31-23

2101-06-B-3 (Mar 1, 2022, Update TTM 37743 Review, Highgrove).docx

Distribution: (1) Addressee (pdf)

ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Suite B
Escondido, California 92029
Telephone: (619) 867-0487 Fax: (714) 409-3287

UPDATED GEOTECHNICAL INVESTIGATION AND REVIEW OF CONCEPTUAL GRADING PLANS TENTATIVE TRACT MAP 37743 HIGHGROVE AREA, COUNTY OF RIVERSIDE, CALIFORNIA

Prepared for:
Steven Walker Communities
7111 Indiana Avenue, Suite 300
Riverside, California 92504

Prepared by:
Advanced Geotechnical Solutions, Inc.
485 Corporate Drive, Suite B
Escondido, California 92029

January 22, 2021
Report No. 2101-06-B-2
P/W 2101-06

Steven Walker Communities
4590 MacArthur Boulevard, Suite 600
Newport Beach, California 92660

January 22, 2021
P/W 2101-06
Report No. 2101-06-B-2

Attention: Mr. Steve Berzansky

Subject: ***Updated Geotechnical Evaluation and Review of Conceptual Grading Plans, Tentative Tract 37743, Highgrove Area, County of Riverside, California***

References: See Appendix

Gentlepersons:

Pursuant to your request, Advanced Geotechnical Solutions, Inc. (AGS) presents herein its geotechnical review of the 40-scale Conceptual Grading Plans prepared by Woodard Group for the commercial and residential portions of Tract 37743, northeast of Center Street and Mount Vernon Avenue in the Highgrove Area, County of Riverside, California. This review has utilized geotechnical and geologic data presented in the referenced reports.

Advanced Geotechnical Solutions, Inc., appreciates the opportunity to provide you with geotechnical consulting services and professional opinions. If you have any questions, please contact the undersigned at (619) 867-0487.

Respectfully Submitted,
Advanced Geotechnical Solutions, Inc.

JOHN J. DONOVAN
RCE 65051, RGE 2790, Reg. Exp. 6-30-21

REGISTERED PROFESSIONAL ENGINEER
JOHN J. DONOVAN
GE 2790
GEOTECHNICAL
STATE OF CALIFORNIA

PAUL J. DERISI
CEG 2536, Reg. Exp. 5-31-21

PROFESSIONAL GEOLOGIST
PAUL J. DERISI
No. 2536
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Distribution: (1) Addressee (electronic copy)

2101-06-B-2 (Jan 22, 2021, Updated GP Review).docx

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ATTACHMENTS:

UPDATED GEOTECHNICAL EVALUATION AND CONCEPTUAL GRADING PLAN REVIEW TENTATIVE TRACT MAP 37743 HIGHGROVE AREA, COUNTY OF RIVERSIDE, CALIFORNIA

1.0 INTRODUCTION

This report presents the results of Advanced Geotechnical Solutions (AGS) updated geotechnical evaluation and review of the 40-scale Conceptual Grading Plans prepared by Woodard Group (2020) for the commercial and residential portions of Tentative Tract Map 37743 in the Highgrove Area, County of Riverside, California. The purpose of our review and report is to present geologic and geotechnical information obtained during previous geotechnical studies onsite relative to the 40-scale Conceptual Grading Plans relative to: 1) existing site soil and geology; 2) engineering characteristics of the onsite earth materials; 3) remedial grading; 4) earthwork recommendations; 5) seismic design parameters; and 6) preliminary foundation and retaining wall design parameters.

1.1. Scope of Work

The scope of our current study consists of the following:

- Reviewing the referenced reports;
- Conducting site reconnaissance;
- Analyzing previously generated subsurface and laboratory data relative to the 40-scale Conceptual Grading Plans and developing site grading recommendations;
- Evaluating the allowable soil bearing pressures and material properties of onsite materials and providing recommendations relative to the design of foundations, retaining walls, and concrete slabs;
- Conducting a seismicity study;
- Preparing and publishing this report which presents geotechnical recommendations pertinent to the accompanying 40-scale Conceptual Grading Plans for Tentative Tract Map No. 37743.

1.2. Geotechnical Study Limitations

The conclusions and recommendations in this report are professional opinions based on the data developed during the site investigations by Soils Southwest, Inc. (SSI, 2005) and AGS (2017). The conclusions presented herein are based upon the current design as reflected on the Conceptual Grading Plans. Changes to the plan would necessitate further review.

The materials immediately adjacent to or beneath those observed and sampled may have different characteristics than those observed and sampled. No representations are made as to the quality or extent of materials not observed. Any evaluation regarding the presence or absence of hazardous material is beyond the scope of this firm's services.

2.0 SITE LOCATION AND DESCRIPTION

2.1. Site Location

The site is located northeast of the intersection of Center Street and Mount Vernon Avenue in the Highgrove area of Riverside County (Figure 1). Existing residences bound the site on the north and east. Center Street bounds the site on the south, and Mount Vernon Avenue bounds the site on the west. The site is relatively flat-lying, with a gentle slope to the west-southwest. Blue Mountain is located northeast of the site.

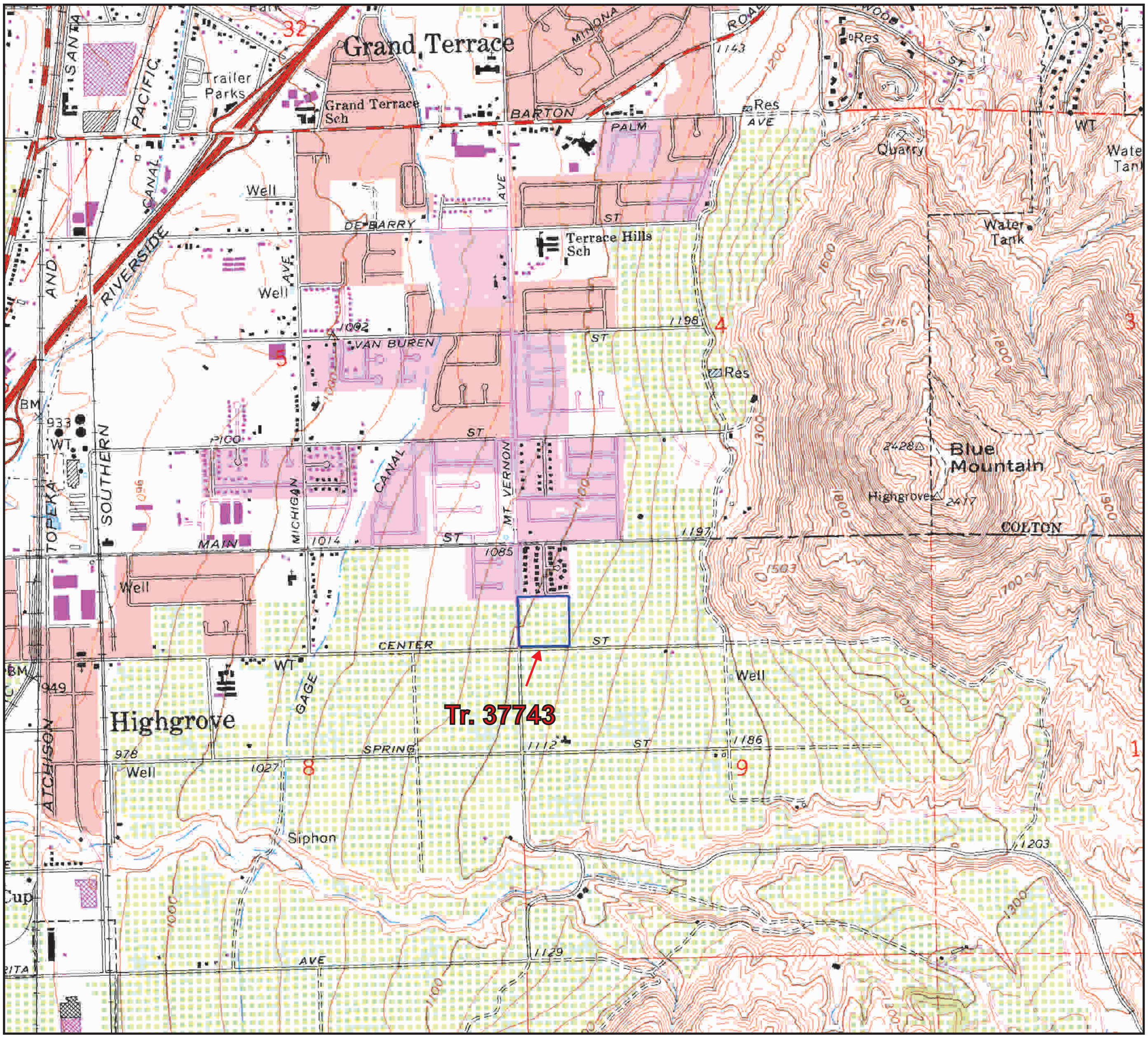
2.2. Site Description

The site is presently vacant and covered with grasses. Overall, the site encompasses approximately 860 feet by 840 feet and drains to the west-northwest. Elevations on site range from a high of 1126 msl on the southeasterly boundary to 1095 msl at the northwest corner of the site, for a total of 31 feet of relief.

2.3. Site History

Historically, the site has been used for agricultural purposes. Minor grading associated with the historic agricultural use has likely occurred on the site, and end-dumped spoil piles associated with construction of the adjacent residential development were observed to occupy the eastern portion of the site on the historic aerial photographs. A summary of site conditions observed on historical photographs/imagery is provided below.

- 1938 – The site and site vicinity are covered with orchards. No structures or improvements observed.
- 1948 – No changes observed.
- 1966 – Residential development appears along northern site boundary. Site and remainder of site vicinity remains as orchards.
- 1994 – The orchard has been removed from the site. A row of palm trees appears along the southern site boundary. Residences appear along Mount Vernon Avenue, across the street from the site.
- 2005 – Grading activities appear to be constructing building pads for single family residences along the eastern site boundary. Grading appears to extend into the eastern half of the site. Orchard has been removed from southern site boundary, across Center Street.
- 10/2005 - 11/2013 – End-dump piles are seen throughout most of the eastern portion and northwest corner of the site.
- 2009 – Housing tract has been completed along the eastern site boundary.
- 4/2014 – The end-dump piles have been spread-out.
- 2/2016 – The site is covered by grass.
- 10/2016 - 4/2020 – The site has been grubbed. Minor changes observed since prior photograph.



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SCALE: 1 in. = 2000 ft.

U.S.G.S. SITE LOCATION MAP
TENTATIVE TRACT 37743
HIGHGROVE AREA
COUNTY OF RIVERSIDE, CALIFORNIA

Latitude: 34.0166° N
Longitude: -117.3124° W

FIGURE 1

SOURCE MAP(S): San Bernardino South U.S.G.S. 7.5-minute Quadrangle

AGS
ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Ste B, Escondido, California 92029
Telephone: (619) 867-0487
P/W 2101-06 **Report No. 2101-06-B-2**

3.0 PROPOSED DEVELOPMENT

Based on our review of the 40-scale conceptual grading plan for the residential portion of Tentative Tract Map 37743, it is proposed to develop a total of 52 residential lots, a recreation structure, a tot lot, two WQMP Infiltration Basins, open space, parking and interior streets on the eastern and northern areas of the site. According to the 40-scale conceptual grading plan for the commercial portion of Tentative Tract Map 37743, a retail building and a gas station with associated driveways and parking will be constructed on the southwest corner of the site. Access to the residential portion will be provided via Center Street.

Design cuts and fill depths of up to 12 and 6 feet, respectively, are proposed. Retaining walls up to 10 feet in height will be constructed along the southeastern limit of the site. Combined with the recommended remedial grading, maximum depths of fill may approach 13 feet in the commercial area of the site. Owing to the gentle topography and proposed remedial grading, the maximum fill differential across residential lots is expected to be generally less than 5 feet. Cut and fill slopes of approximately 2 feet in height are proposed. All slopes are designed at 2:1 (H:V) inclinations or flatter.

4.0 FIELD AND LABORATORY INVESTIGATIONS

4.1. Previous Investigations

A preliminary geotechnical investigation for the site was conducted in 2005 by SSI. Their investigation included four soil borings advanced to depths of up to 31 feet below existing surface and limited laboratory testing of collected soil samples (SSI, 2005). Boring logs and laboratory test results from that investigation are included in Appendix B.

In 2010, GSS Engineering performed infiltration testing at the site. Three test pits were excavated in the northwest corner of the site. Infiltration testing was conducted at depths of 3, 5, and 7 feet using a double ring infiltrometer. Infiltration rates of 1.1 to 1.8 inches per hour were reported.

In 2016, AGS reviewed the previous site investigation reports (SSI 2005; GSS Engineering 2010, and Soil Exploration Company 2013) and conducted site reconnaissance and field mapping at the site as part of this work, as well as reviewing available geotechnical and geologic information for the site vicinity.

In 2020, GeoMat Testing Laboratories, Inc. (GeoMat) performed four borehole percolation tests at the site. The boreholes extended to 8 feet below existing grade. Adjusted infiltration rates of 1.08 to 1.39 inches per hour were reported.

5.0 ENGINEERING GEOLOGY

5.1. Geologic Analysis

5.1.1. Literature Review

AGS has reviewed the referenced geologic documents in preparing this study. Where deemed appropriate, this information has been included with this document.

5.1.2. Aerial Photograph Review

AGS has reviewed current and historical aerial photographs and satellite imagery available through sources on the internet.

5.1.3. Field Mapping

The site geology was mapped during our site reconnaissance.

5.2. Geologic and Geomorphic Setting

The site is located within the Perris Block of the Peninsular Ranges geomorphic province bounded by the Santa Ana Mountains at the southwest and the San Bernardino Mountains at the northeast.

5.3. Stratigraphy

Based on our review of regional geologic maps (Morton and Miller 2003), the site is underlain by Old Alluvial Fan Deposits (Qof) derived from the nearby granitic mountains (Figure 2). A mid-to-late Pleistocene age has been assigned to this unit. In some areas of the site, undocumented artificial fill (afu) overlies the old alluvial fan deposits. The estimated lateral distribution of these units is presented on the enclosed Geotechnical Map (Plate 1) which is based on the conceptual grading plans for the project. Detailed descriptions are presented below.

5.3.1. Undocumented Artificial Fill (afu)

Undocumented artificial fill was observed to be placed as end-dumped piles within most of the eastern half of the site. The end-dump piles appear in the historic aerial imagery from October 2005 through November 2013. The piles have been spread-out in the April 2014 aerial imagery. Minor amounts of man-made debris may exist within this fill. The thickness of fill is estimated to be on the order of 2 to 3 feet.

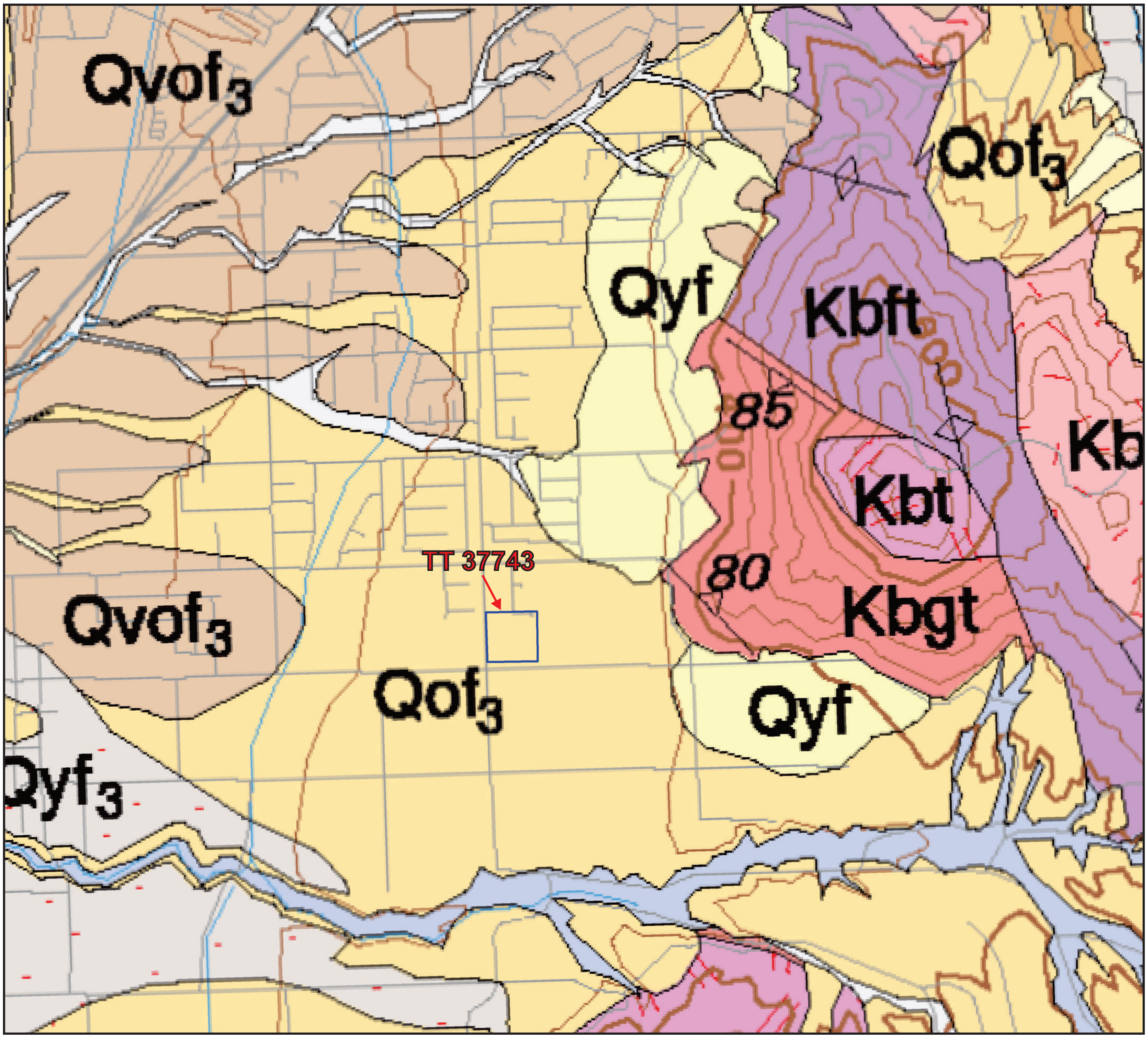
5.3.2. Old Alluvial Fan Deposits (Qof)

The old alluvial fan deposits surface dips shallowly to the west. These consolidated deposits are moderately dissected. This unit consists predominantly of brown to light brown and yellow brown, dry to moist, fine- to medium-grained sand with silt, some pebbles and rock fragments. These deposits were also noted to be slightly porous. The upper five feet were reported to be weathered, porous and less dense than the materials below.

5.4. Geologic Structure and Tectonic Setting

5.4.1. Tectonic Setting

The site is located within the within the Perris Block geomorphic province, a relatively stable zone of the Peninsular Ranges Structural Province (Woodford et al 1971). Two major active faults are present along the boundaries of this region. The San Jacinto Fault is located to the northeast and the Elsinore Fault is located to the southwest of the site.



REGIONAL GEOLOGIC MAP
TENTATIVE TRACT 37743
HIGHGROVE AREA
COUNTY OF RIVERSIDE, CALIFORNIA

FIGURE 2

SOURCE MAP(S): USGS 2003, Preliminary Geologic Map of the 30'x60' San Bernardino Quadrangle

AGS
ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Ste B, Escondido, California 92029
Telephone: (619) 867-048

P/W 2101-06 **Report No. 2101-06-B-2**

5.4.2. Regional Faulting

The closest regional faults that are capable of affecting the site are the San Andreas Fault and the San Jacinto Fault (Figure 3, Fault Map).

5.4.2.1. *San Jacinto Fault System*

The San Jacinto fault zone is the closest active fault to the site and consists of a series of closely spaced faults that form the western margin of the San Jacinto Mountains. The San Jacinto fault zone has a high level of historical seismic activity, with at least ten damaging (Mw 6-7) earthquakes having occurred between 1890 and 1986. Offset on the fault is predominantly right-lateral similar to the San Andreas. Maximum earthquake magnitude of 8.0 is expected on the San Bernardino segment. The closest distance to a mapped splay of the San Jacinto fault (San Bernardino segment) from the site is approximately 2 miles to the northeast.

5.4.2.2. *San Andreas Fault System*

The active San Andreas Fault zone is located approximately 10 miles northeast of the project. This fault zone is California's most prominent structural feature, trending in a general northwest direction almost the entire length of the state. The last major earthquake along the San Andreas fault zone in Southern California was the 1857 Magnitude 8.3 Fort Tejon earthquake.

5.4.3. Geologic Structure

The site is underlain by old alluvial fan deposits. Bedding was not observed within this unit, and it is assumed that it exists as a flat-lying unit with a slight dip to the west. No faults have been mapped within the site, or immediate site vicinity.

5.5. Groundwater

Groundwater was not encountered during previous subsurface investigations at the site. Groundwater is estimated to be several hundred feet below the existing grade and is not expected to impact site development. It should be noted that localized perched groundwater may develop at a later date, most likely at or near fill/formation contacts, due to fluctuations in precipitation, irrigation practices, or factors not evident at the time of our field explorations.

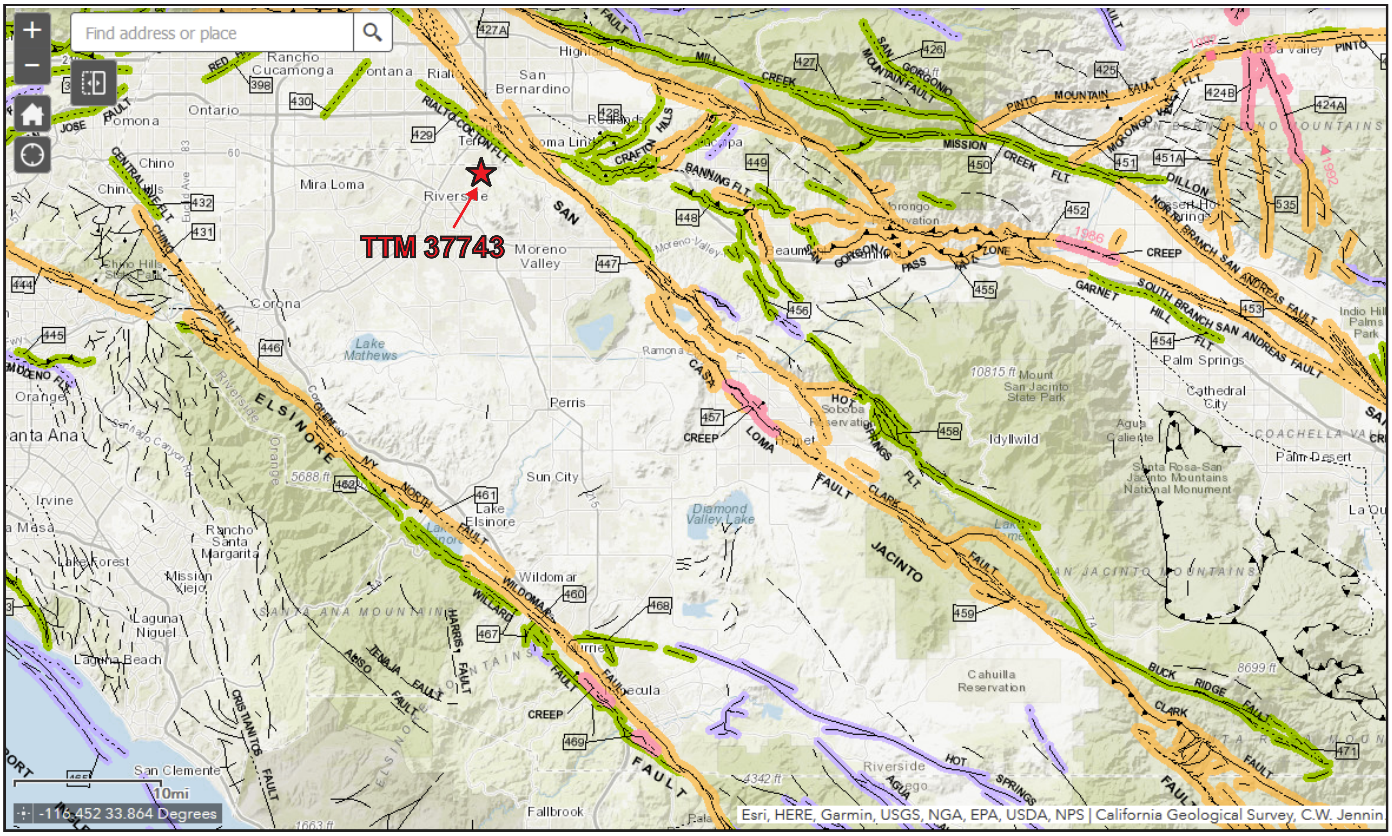
5.6. Non-seismic Geologic Hazards

5.6.1. Mass Wasting

Due to the developed nature of the surrounding area and the flat lying topography, mass wasting and debris flows are not considered a geologic hazard to the site.

5.6.2. Flooding

According to FEMA, the site is located in Zone X corresponding to minimal flood hazard.



FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

Fault along which historic (last 200 years) displacement has occurred.

Holocene fault displacement (during past 11,700 years) without historic record.

Late Quaternary fault displacement (during past 700,000 years).

Quaternary fault (age undifferentiated).

N

SCALE: 1 in. = 10 mile

FAULT ACTIVITY MAP
TENTATIVE TRACT MAP 37743
HIGHGROVE AREA
COUNTY OF RIVERSIDE, CALIFORNIA

FIGURE 3

SOURCE MAP: USGS, 2010, Fault Activity Map of California: California Geological Survey Geologic Data Map No. 6

AGS
ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Ste B, Escondido, California 92029
Telephone: (619) 867-0487 Fax: (714) 409-3287
P/W 2101-06 Report No. 2101-06-B-2

5.6.3. Subsidence and Ground Fissuring

Due to the dense nature of the old alluvial fan deposits underlying the site, as well as the anticipated removal of the weathered old alluvial fan deposits and undocumented fill, the potential for subsidence and ground fissuring due to settlement of the underlying earth materials is unlikely.

5.7. Seismic Hazards

The site is located in the tectonically active Southern California area, and will therefore likely experience shaking effects from earthquakes. The type and severity of seismic hazards affecting the site are to a large degree dependent upon the distance to the causative fault, the intensity of the seismic event, the direction of propagation of the seismic wave and the underlying soil characteristics. The seismic hazard may be primary, such as surface rupture, earthquake-induced landsliding and/or ground shaking, or secondary, such as liquefaction, seismically induced slope failure or dynamic settlement. The following is a site-specific discussion of potential seismic hazards and potential mitigations, if necessary, to reduce the hazard to an acceptable level of risk. The following seismic hazards discussion is guided by the 2019 California Building Code, CDMG (2008), and Martin and Lew (1998).

5.7.1. Surface Fault Rupture

Surface rupture is a break in the ground surface during or as a consequence of seismic activity. To a large part, research supports the conclusion that active faults tend to rupture at or near pre-existing fault planes. The site is not located in a State of California Alquist-Priolo Fault Zone and faulting has not been mapped at the site. It is AGS's opinion that the likelihood of significant fault rupture on the site is low.

5.7.2. Historical Earthquakes

Earthquakes that have historically impacted the area include the 1857 Fort Tejon Earthquake, the 1858 San Bernardino Earthquake, the 1899 Cajon Pass earthquake, the 6.8 magnitude 1918 San Jacinto earthquake near Hemet, the 6.3 magnitude 1923 North San Jacinto earthquake near Highgrove, the 1981 Sylmar Earthquake, the 5.9 magnitude 1987 Whittier Narrows Earthquake, the 6.4 magnitude Big Bear earthquake, 6.7 magnitude 1994 Northridge Earthquake, and 5.4 magnitude 1990 Upland earthquake.

FIGURE 5.7.2 - MAP OF HISTORIC EARTHQUAKES (1910-PRESENT)

5.7.3. Seismic Design Parameters

The following seismic design parameters are presented to be code compliant to the 2019 California Building Code. Upon completion of grading, the lots will be underlain with varying depths of fill over old alluvial soils. Based on this assumption, the site has been classified as Seismic Site Class D - stiff soil profile. Table 5.7.3 presents seismic design parameters for Seismic Site Class D in accordance with 2019 CBC and mapped spectral acceleration parameters (United States Geological Survey, 2019) utilizing site coordinates of Latitude 34.0166°N and Longitude 117.3124°W.

TABLE 5.7.3 2019 CBC SEISMIC DESIGN PARAMETERS	
Seismic Site Class	D
Mapped Spectral Acceleration Parameter at Period of 0.2-Second, S_s	1.866g
Mapped Spectral Acceleration Parameter at Period 1-Second, S_1	0.734g
Site Coefficient, F_a	1.000
Site Coefficient, F_v	N/A[3]
Adjusted MCE$_R$[1] Spectral Response Acceleration Parameter at Short Period, S_{MS}	1.866g
1-Second Period Adjusted MCE$_R$[1] Spectral Response Acceleration Parameter, S_{M1}	N/A[3]
Short Period Design Spectral Response Acceleration Parameter, S_{DS}	1.244g
1-Second Period Design Spectral Response Acceleration Parameter, S_{D1}	N/A[3]
Peak Ground Acceleration, PGA$_M$[2]	0.867g
Seismic Design Category	N/A[3]

Notes: [1] Risk-Targeted Maximum Considered Earthquake
[2] Peak Ground Acceleration adjusted for site effects
[3] Requires Site Specific Ground Motion Hazard Analysis per ASCE 7-16 Section 11.4.8

As indicated in Note 3 above, ASCE 7-16 Section 11.4.8 requires a site specific ground motion hazard analysis unless, per Exception 2, the value of the seismic response coefficient, C_S, is determined by Equation (12.8-2) for values of T ≤ 1.5TS and taken as equal to 1.5 times the values computed with either Equation (12.8-3) for $T_L \geq T > 1.5Ts$ or Equation (12.8-4) for $T > T_L$.

5.7.4. Liquefaction/Dynamic Settlement

Liquefaction is the phenomenon in which the buildup of excess pore pressures, in saturated granular soils due to seismic agitation, results in a temporary "quick" or "liquefied" condition. The site is mapped by the County of Riverside as being in an area with a low susceptibility to liquefaction. Due to the lack of shallow groundwater and the relatively dense nature of the underlying old alluvial fan deposits, the potential for liquefaction is low. Upon completion of remedial grading, seismically induced dynamic settlement in non-saturated deposits (dry sand settlement) is not expected to adversely impact the site.

5.7.5. Lateral Spreading

Liquefaction-induced lateral spreading is defined as the finite, lateral displacement of gently sloping ground as a result of pore pressure build-up or liquefaction in a shallow underlying deposit during an earthquake. Due to the lack of shallow groundwater, the potential for lateral spreading is very low.

5.7.6. Seismically Induced Landsliding

The site is very gently sloping to level, and nearby significant slopes are not present. As such, the possibility for seismically induced landsliding to impact the development is considered nil.

5.7.7. Earthquake Induced Flooding

Earthquake induced flooding can be caused by tsunamis, dam failures, or seiches. Also, earthquakes can cause landslides that dam rivers and streams, causing flooding upstream above the dam and also downstream when these dams are breached. A seiche is a free or standing-wave oscillation on the surface of water in an enclosed or semi-enclosed basin. The wave can be initiated by an earthquake and can vary in height from several centimeters to a few meters. Due to the lack of a freestanding body of water nearby, the potential for a seiche impacting the site is considered to be non-existent.

Considering the lack of any dams or permanent water sources upstream, earthquake induced flooding caused by a dam failure is considered to be non-existent.

Considering the distance of the site from the coastline, the potential for flooding due to tsunamis is extremely low.

6.0 GEOTECHNICAL ENGINEERING

Presented herein is a general discussion of the geotechnical properties of the various soil types and the analytic methods used in this report.

6.1. Material Properties

6.1.1. Excavation Characteristics

Based on our previous experience with similar projects near the subject site and the information gathered during our investigation for this report, it is our opinion that the earth materials onsite can be readily excavated with conventional grading equipment.

6.1.2. Compressibility

The onsite materials that are compressible include; topsoil, undocumented artificial fill, and weathered old alluvial fan deposits. These compressible materials will require removal from fill areas prior to placement of fill and where exposed at grade in cut areas.

6.1.3. Collapse Potential/Hydro-Consolidation

Hydro-consolidation is a singular response to the introduction of water into collapse-prone alluvial soils. Upon initial wetting, the soil structure and apparent strength are altered and a virtually immediate settlement response occurs. The topsoil, artificial fill, and weathered old alluvial fan deposits are subject to hydro-consolidation and therefore will need to be removed before placement of compacted fill. Two consolidation tests conducted by SSI indicated a high potential for hydro-collapse (~ 5 percent) for a sample from boring B-2 at 5 ft. depth and a slight to moderate potential (~1 percent) for a sample from boring B-1 at 8 ft. depth. The deeper unweathered old alluvial fan deposits are considered to have a slight potential for hydro-consolidation.

6.1.4. Expansion Potential

The expansion potential of the onsite materials is expected to be "very low" to "low" when classified in accordance with ASTM D 4829. Further testing should be conducted during grading operations to verify specific as-graded conditions on a lot-by-lot basis and provide design recommendations accordingly.

6.1.5. Shear Strength

Shear strength testing was conducted by SSI on one remolded sample of alluvial materials. The results are presented in Appendix B. The shear strengths used by AGS for design are presented in Table 6.1.5.

TABLE 6.1.5
DESIGN SHEAR STRENGTH PARAMETERS (ULTIMATE)

Material	Cohesion (psf)	Friction Angle (degrees)	Moist Density (pcf)
Compacted Fill and Older Alluvium	275	33	130

6.1.6. Corrosivity

Testing for soluble sulfate and chloride content, pH and resistivity of site soils was not performed by AGS. Based upon the fine- to medium-grained silty sands and clayey sands found onsite, we anticipate that some of the onsite soils may be corrosive to ferrous metals. Upon completion of grading, samples should be collected and tested. Final recommendations should be based on the results of those tests.

6.1.7. Earthwork Adjustments

The following average earthwork adjustment factors are presented for use in evaluating earthwork quantities. These numbers are considered approximate and should be refined during grading when actual conditions are better defined. Contingencies should be made to adjust the earthwork balance during grading if these numbers are adjusted.

TABLE 6.1.7
EARTHWORK ADJUSTMENTS

Geologic Unit	Approximate Range
Topsoil and Undocumented Fill	15 to 25 percent shrinkage
Weathered Old Alluvial Fan Deposits	5 to 15 percent shrinkage

6.1.8. Pavement Support Characteristics

Compacted fill derived from onsite soils is expected to possess "moderate" to "good" pavement support characteristics. Testing should be completed once subgrade elevations are reached for the onsite roadways. For initial design we used a Resistance Value of 30.

6.2. Analytical Methods

6.2.1. Pavement Design

Asphalt concrete pavement sections have been designed using the recommendations and methods presented in the Caltrans Highway Design Manual.

6.2.2. Bearing Capacity and Lateral Pressure

Ultimate bearing capacity values were obtained using the graphs and formula presented in NAVFAC DM-7.1. Allowable bearing was determined by applying a factor of safety of at least 3 to the ultimate bearing capacity. Static lateral earth pressures were calculated using Rankine methods for active and passive cases.

7.0 EARTHWORK CONCLUSIONS AND RECOMMENDATIONS

Based on the information presented herein and our experience in the vicinity of the subject site, it is AGS's opinion that the proposed development of the residential and commercial portions of Tentative Tract Map 37743 is feasible, from the geotechnical point of view, provided that the recommendations provided in this report are incorporated in the design and construction of the proposed structures. All grading shall be accomplished under the observation and testing of the project Geotechnical Consultant in accordance with the recommendations contained herein, the current codes practiced by the County of Riverside and this firm's Earthwork Specifications (Appendix C).

7.1. Site Preparation and Removals/Overexcavation

Topsoil, artificial fill, and weathered old alluvial fan deposits should be removed prior to placement of fill and where exposed at finish grade. Guidelines to determine the depth of removals are presented below; however, the exact extent of the removals must be determined in the field during grading, when observation and evaluation of the greater detail afforded by those exposures can be performed by the Geotechnical Consultant. In general, removed soils will be suitable for reuse as compacted fill when free of deleterious materials and after moisture conditioning.

7.1.1. Site Preparation

Existing vegetation, trash, debris, irrigation lines and foundation elements should be removed and wasted from the site prior to commencing removal of unsuitable soils and placement of compacted fill materials. Concrete can be placed in deeper fill areas provided it is broken down into pieces smaller than 12 inches (largest dimension). Cesspools and septic systems should be properly removed and/or backfilled in accordance with the local governing agency.

7.1.2. Topsoil (unmapped)

Loose, compressible topsoil should be removed to expose the underlying competent old alluvial fan deposits prior to placement of compacted fill and when exposed in shallow cut areas. An average removal depth of 1 to 2 feet is anticipated for removal of topsoil. In general, onsite soils are suitable to be re-used as structural fill when properly moisture conditioned.

7.1.3. Undocumented Artificial Fill (afu)

Undocumented artificial fill should be removed prior to fill placement. Removals should extend below the undocumented fill until competent old alluvial fan deposits are encountered.

7.1.4. Old Alluvial Fan Deposits (Qof)

The Old Alluvial Fan Deposits were generally observed to be medium dense to dense and suitable for support of fill. The weathered portion (4 to 7 feet) of the old alluvial fan deposits will require removal to expose competent material.

7.1.5. Overexcavation

It is recommended that cut lots and cut-fill transition lots created after removal activities be overexcavated to provide a minimum of four (4) feet of compacted engineered fill below pad grades, or two (2) feet below foundations, whichever is deeper. Streets should be overexcavated to provide a minimum of 2 feet of compacted fill below the subgrade.

7.1.6. Removals Along Grading Limits and Property Lines

Cuts up to 10 feet in depth and removals of unsuitable soils will be required prior to construction of retaining walls or fill placement along the grading limit. A 1:1 projection, from toe of slope or grading limit, outward to competent materials should be established, where possible. Where removals are not possible due to grading limits, property line or easement restrictions, removals should be initiated at the grading boundary (property line, easement, grading limit or outside the improvement) at a 1:1 ratio inward to competent materials. This reduced removal criteria should not be implemented prior to review by the Geotechnical Consultant and approval by the Owner. Where this reduced removal criteria is implemented, special maintenance zones may be necessary. These areas, if present, will need to be identified during grading. Alternatively, grading limits could be initiated offsite if grading permission is provided by the owners of neighboring properties.

7.2. Temporary Backcut Stability

Temporary backcuts should be laid back at gradients no steeper than 1:1 to heights of up to 10 feet, and 1½:1 (horizontal:vertical) for heights greater than 10 feet. Flatter backcuts may be necessary where geologic conditions dictate and where minimum width dimensions are to be maintained.

Care should be taken during remedial grading operations in order to minimize risk of failure. Should failure occur, complete removal of the disturbed material will be required.

Shoring may be necessary to construct the retaining wall along the easterly side of the property if backcuts cannot be initiated offsite. Cantilever shoring can be designed in accordance with the recommendations in Section 8.2.

In consideration of the inherent instability created by temporary construction of backcuts, it is imperative that grading schedules be coordinated to minimize the unsupported exposure time of these excavations. Once started these excavations and subsequent fill operations should be maintained to completion without intervening delays imposed by avoidable circumstances. In cases where five-day workweeks comprise a normal schedule, grading should be planned to avoid exposing at-grade or near-grade excavations through a non-work weekend. Where improvements may be affected by temporary instability, either on or offsite, further restrictions such as slot cutting, extending work days, implementing weekend schedules, and/or other requirements considered critical to serving specific circumstances may be imposed.

7.3. Subsurface Drainage

Canyon subdrains are not anticipated for this project due to the relatively flat topography of the site. Heel drains shall be placed at the heel of all fill-over-cut keyways and drains should be installed behind all retaining walls.

7.4. Seepage

Seepage, when encountered during grading, should be evaluated by the Geotechnical Consultant. In general, seepage is not anticipated to adversely affect grading. If seepage is excessive, remedial measures such as horizontal drains or under drains may need to be installed. No groundwater or seepage was encountered during the investigation; therefore, seepage is not expected.

7.5. Earthwork Considerations

7.5.1. Compaction Standards

All fills should be compacted to at least 90 percent of the maximum dry density as determined by ASTM D1557. All loose and or deleterious soils should be removed to expose firm native soils or bedrock. Prior to the placement of fill, the upper 6 to 8 inches should be ripped, moisture conditioned to optimum moisture or slightly above optimum, and compacted to a minimum of 90 percent of the maximum dry density (ASTM D1557). Fill should be placed in thin (6 to 8-inch) lifts, moisture conditioned to optimum moisture or slightly above, and compacted to 90 percent of the maximum dry density (ASTM D1557) until the desired grade is achieved.

7.5.2. Benching

Where the natural slope is steeper than 5-horizontal to 1-vertical and where determined by the Geotechnical Consultant, compacted fill material shall be keyed and benched into competent materials.

7.5.3. Mixing and Moisture Control

In order to prevent layering of different soil types and/or different moisture contents, mixing and moisture control of materials will be necessary. The preparation of the earth materials through mixing and moisture control should be accomplished prior to and as part of the compaction of each fill lift. Water trucks or other water delivery means may be necessary for moisture control. Discing may be required when either excessively dry or wet materials are encountered.

7.5.4. Haul Roads

All haul roads, ramp fills, and tailing areas shall be removed prior to engineered fill placement.

7.5.5. Import Soils

Import soils, if required, should consist of clean, structural quality, compactable materials similar to the on-site soils and should be free of trash, debris or other objectionable materials. Import soils should be tested and approved by the Geotechnical Consultant prior to importing. At least three working days should be allowed in order for the geotechnical consultant to sample and test the potential import material.

7.5.6. Oversize Rock

Oversize rock is not anticipated to be encountered within the old alluvial fan deposits at the site. If encountered, rock over 8-inches should not be placed within 10 feet of finish grade or within 2 feet of the deepest utility in the streets. Oversize rock should be kept minimally 5 feet outside and below proposed culverts, pipes, etc.

7.5.7. Fill Slope Construction

Fill slopes may be constructed by preferably overbuilding and cutting back to the compacted core or by back-rolling and compacting the slope face. The following recommendations should be incorporated into construction of the proposed fill slopes.

Care should be taken to avoid spillage of loose materials down the face of any slopes during grading. Spill fill will require complete removal before compaction, shaping and grid rolling.

Seeding and planting of the slopes should follow as soon as practical to inhibit erosion and deterioration of the slope surfaces. Proper moisture control will enhance the long-term stability of the finish slope surface.

7.5.7.1. *Overbuilding Fill Slopes*

Fill slopes should be overfilled to an extent determined by the contractor, but not less than 2 feet measured perpendicular to the slope face, so that when trimmed back to the compacted core, the compaction of the slope face meets the minimum project requirements for compaction.

Compaction of each lift should extend out to the temporary slope face. The sloped should be back-rolled at fill intervals not exceeding 4 feet in height unless a more extensive overfilling is undertaken.

7.5.7.2. *Compacting the Slope Face*

As an alternative to overbuilding the fill slopes, the slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Back-rolling at more frequent intervals may be required. Compaction of each fill should extend to the face of the slope. Upon completion, the slopes should be watered, shaped, and track-walked with a D-8 bulldozer or similar equipment until the compaction of the slope face meets the minimum project requirements. Multiple passes may be required.

7.5.8. Utility Trench Excavation and Backfill

All utility trenches should be shored or laid back in accordance with applicable OSHA standards. Mainline and lateral utility trench backfill should be compacted to at least 90 percent of maximum dry density as determined by ASTM D 1557. Onsite soils may be suitable for use as bedding material and will be suitable for use in backfill, provided oversized materials are removed. No surcharge loads should be imposed above excavations. This includes spoil piles, lumber, concrete trucks or other construction materials and equipment. Drainage above excavations should be directed away from the banks. Care should be taken to avoid saturation of the soils. Compaction should be accomplished by mechanical means. Jetting of native soils will generally not be acceptable.

To reduce moisture penetration beneath the slab-on-grade areas, shallow utility trenches should be backfilled with lean concrete or concrete slurry where they intercept the foundation perimeter. As an alternative, such excavations can be backfilled with native soils, moisture-conditioned to over optimum, and compacted to a minimum of 90 percent relative compaction.

7.5.9. Flatwork and Slab-on-Grade Subgrade Preparation

7.5.9.1. *Slab-on-Grade Subgrade*

The subgrade below the slab-on-grade should be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557.

The subgrade below exterior slabs, sidewalks, driveways, patios, etc. should be moisture conditioned to a minimum of 110 percent of optimum moisture content prior to concrete placement.

7.5.9.2. *Flatwork Subgrade*

The subgrade below exterior slabs, sidewalks, driveways, patios, etc. should be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557.

The subgrade below exterior slabs, sidewalks, driveways, patios, etc. should be moisture conditioned to a minimum of 110 percent of optimum moisture content prior to concrete placement.

8.0 DESIGN RECOMMENDATIONS

From a geotechnical perspective, the proposed development is feasible provided the following recommendations are incorporated into the design and construction. Preliminary design recommendations are presented herein and are based on the general soils conditions encountered during the referenced geotechnical investigations. As such, recommendations provided herein are considered preliminary and subject to change based on the results of additional observation and testing that will occur during grading operations. Final design recommendations should be provided in a final rough/precise grading report.

8.1. Structural Design Recommendations

The proposed residential and commercial structures can be supported on either post-tensioned foundations or conventionally reinforced foundations.

8.1.1. Foundation Design

8.1.1.1. *Conventional Foundations*

Foundations may be designed using the values provided in the following table. These values may be increased as allowed by Code to resist transient loads such as wind or seismic. Building code and structural design considerations may govern depth and reinforcement requirements and should be evaluated.

TABLE 8.1.1.1 CONVENTIONAL FOUNDATION DESIGN PARAMETERS	
Allowable Bearing	2,000 psf, based on a minimum width and depth
Lateral Bearing (Level Condition)	350 psf/foot of depth to a maximum of 2,000 psf
Lateral Bearing (Descending 2:1 Slope)	150 psf/foot of depth to a maximum of 1,500 psf
Sliding Coefficient	0.35
Expansion Index	**"Very Low" to "Low"**
Footing Depth*	12 inches (one story), 18 inches (two stories)
Footing Width	12 inches (one story), 15 inches (two stories)
Reinforcement	No. 4 rebar - 2 on top, 2 on bottom or No. 5 rebar, 1 on top and bottom

Notes on Footing Embedment: Depth of embedment should be measured below lowest adjacent finish grade.

Footings Adjacent to Swales and Slopes: If exterior footings adjacent to drainage swales are to exist within 5 feet horizontally of the swale, the footing should be embedded sufficiently to assure embedment below the swale bottom is maintained. Footings adjacent to slopes should be embedded such that at least 5 feet is provided horizontally from edge of the footing to the face of the slope.

8.1.1.2. *Post Tensioned Foundations*

Post-tensioned foundations may be designed using the values provided in the following table.

TABLE 8.1.1.2
POST-TENSIONED FOUNDATION DESIGN PARAMETERS

Soil Category	Expansion Index	Lot Nos.	Edge Beam Embedment (inches)*	Edge Lift**		Center Lift**	
				Em (ft.)	Ym (in.)	Em (ft.)	Ym (in.)
I	"Very Low to Low"	***	12	5.4	0.54	9.0	-0.23

Moisture Barrier	An approved moisture and vapor barrier should be placed below all slabs-on-grade within living and moisture sensitive areas as discussed in Section 8.1.1.7
Slab Subgrade Moisture	Minimum of 110 percent of optimum moisture to a depth of 12 inches prior to placing concrete
Footing Embedment**	Depth of embedment should be measured below lowest adjacent finish grade. **Footings Adjacent to Swales and Slopes:** If exterior footings adjacent to drainage swales are to exist within 5 feet horizontally of the swale, the footing should be embedded sufficiently to assure embedment below the swale bottom is maintained. Footings adjacent to slopes should be embedded such that at least 5 feet is provided horizontally from edge of the footing to the face of the slope.

NOTES: **The values of predicted lift are based on the procedures outlined in the *Design of Post-Tensioned Slabs-on-Ground*, Third Edition and related addendums. No corrections for vertical barriers at the edge of the slab or other corrections (e.g. horizontal barriers, tree roots, adjacent planters) are assumed. The values assume Post-Equilibrium conditions exist (as defined by the Post Tensioning Institute), and these conditions created during construction should be maintained throughout the life of the structure. Please refer to the appended Homeowner Maintenance Guidelines for a summary of recommended practices to maintain the conditions created during construction.

***Final design parameters should be provided in a final grading report and should be based on as-graded soil conditions. For budgeting purposes, a Soil Category of I may be assumed.

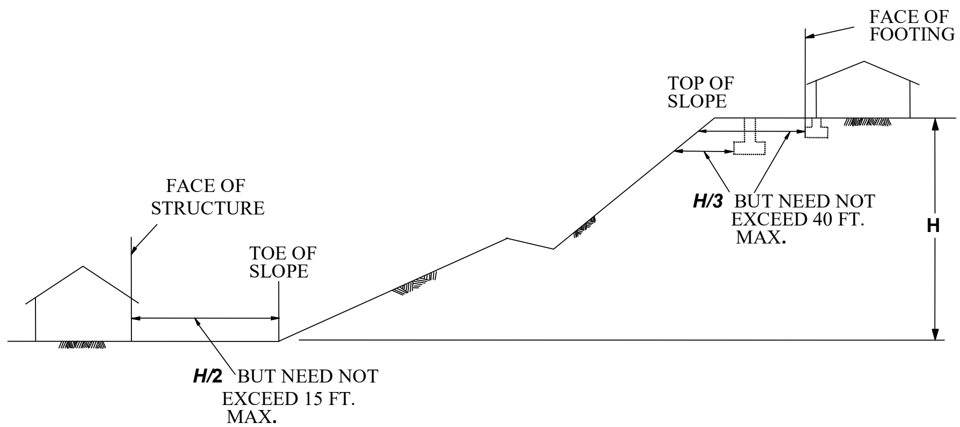
8.1.1.3. *Isolated Footings*

Isolated footings outside the structure footprint should be tied with grade beams to the structure in two orthogonal directions.

8.1.1.4. *Deepened Footings and Setbacks*

Improvements constructed in proximity to natural slopes or properly constructed, manufactured slopes can, over a period of time, be affected by natural processes including gravity forces, weathering of surficial soils and long-term (secondary) settlement. Most building codes, including the California Building Code, require that structures be set back or footings deepened where subject to the influence of these natural processes.

For the subject site, where foundations for residential structures are to exist in proximity to slopes, the footings should be embedded to satisfy the requirements presented in the following figure.



8.1.1.5. *Footing Excavations*

Footing excavations should be observed by the geotechnical consultant. Spoils from the footing excavations should not be placed on slab-on-grade areas unless the soils are properly compacted. The footing excavations should not be allowed to dry back and should be kept moist until concrete is poured. The excavations should be free of all loose and sloughed materials, be neatly trimmed, and moisture conditioned at the time of concrete placement.

8.1.1.6. *Garage Entrances*

A grade beam reinforced continuously with the garage footings should be constructed across the garage entrance, tying together the ends of the perimeter footings and between individual spread footings. This grade beam should be embedded at the same depth as the adjacent perimeter footings. A thickened slab, separated by a cold joint from the garage beam, should be provided at the garage entrance. The thickened edge should be a minimum of 6 inches deep.

8.1.1.7. *Moisture and Vapor Barrier*

A moisture and vapor retarding system should be placed below the slabs-on-grade in portions of the structure considered to be moisture sensitive. The retarder should be of suitable composition, thickness, strength and low permeance to effectively prevent the migration of water and reduce the transmission of water vapor to acceptable levels. Historically, a 10-mil plastic membrane, such as *Visqueen*, placed between one to four inches of clean sand, has been used for this purpose. More recently Stego® Wrap or similar underlayments have been used to lower permeance to effectively prevent the migration of water and reduce the transmission of water vapor to acceptable levels. The use of this system or other systems, materials or techniques can be considered, at the discretion of the designer, provided the system reduces the vapor transmission rates to acceptable levels.

8.1.1.8. *Settlement*

Settlements are likely to be produced from structural loads and long-term settlement of the fill (secondary consolidation). After remedial grading, the deepest deposits of fill are expected to be on the order of 13 feet. The maximum fill differential across a lot is expected to be on the order of 5 feet.

For foundations designed based on the above values, total settlements under structural loads should be less than ½ inches. Structures should also be designed to accommodate long-term settlement of the fill. The settlement potential and estimated differential settlement should be further evaluated during grading and provided in a final grading report based on the actual depths and properties of the underlying fill, underlying profile, and structure sitings. For preliminary planning purposes, structures should be designed to accommodate differential settlement on the order of 3/8 inch across 20 feet.

8.1.2. Concrete Design

Preliminary testing for sulfate exposure was not conducted by AGS or others. Final testing should be conducted once the final distribution of soils is known after the mass grading. It should be recognized that some fertilizers have been known to leach water-soluble sulfate compounds into soils containing “negligible” sulfate concentrations and increase the sulfate concentrations to potentially detrimental levels. Accordingly, it is suggested that the homeowners be advised of their responsibility to maintain existing conditions.

8.1.3. Retaining Wall Design

The foundations for retaining walls should be founded on competent alluvial deposits or compacted fill and may be designed in accordance with the recommendations provided in Table 8.1.1.1, Conventional Foundation Design Parameters. When calculating the lateral resistance, the upper 12 inches of soil cover should be ignored in areas that are not covered with hardscape. Retaining wall footings should be designed to resist the lateral forces by passive soil resistance and/or base friction as recommended for foundation lateral resistance.

Retaining walls should be designed to resist earth pressures presented in the following table. These values assume that the retaining walls will be backfilled non-expansive free draining materials (Sand Equivalent of 20 or better and an Expansion Index of 20 or less). Most of the materials onsite are considered free-draining and will be suitable for placement behind these walls. If non-free draining materials are utilized, revised values will need to be provided to design the retaining walls. Retaining walls should be designed to resist additional loads such as construction loads, temporary loads, and other surcharges as evaluated by the structural engineer.

TABLE 8.1.3
RETAINING WALL EARTH PRESSURES

"Native" Backfill Materials (γ=130pcf, EI<20)				
	Level Backfill		2:1 Backfill	
	Rankine Coefficients	Equivalent Fluid Pressure (psf / lineal foot)	Rankine Coefficients	Equivalent Fluid Pressure (psf / lineal foot)
Active Pressure	$K_a = 0.29$	38	$K_a = 0.38$	50
Passive Pressure	$K_p = 3.39$	440	$K_p = 2.58$	335
At Rest Pressure	$K_o = 0.46$	59	$K_o = 0.66$	86

In addition to the above static pressures, unrestrained retaining walls located should be designed to resist seismic loading as required by the 2019 CBC. The seismic load can be modeled as a thrust load applied at a point 0.6H above the base of the wall, where H is equal to the height of the wall. This seismic load (in pounds per lineal foot of wall) is represented by the following equation:

$$Pe = \frac{3}{8} * \gamma * H^2 * k_h$$

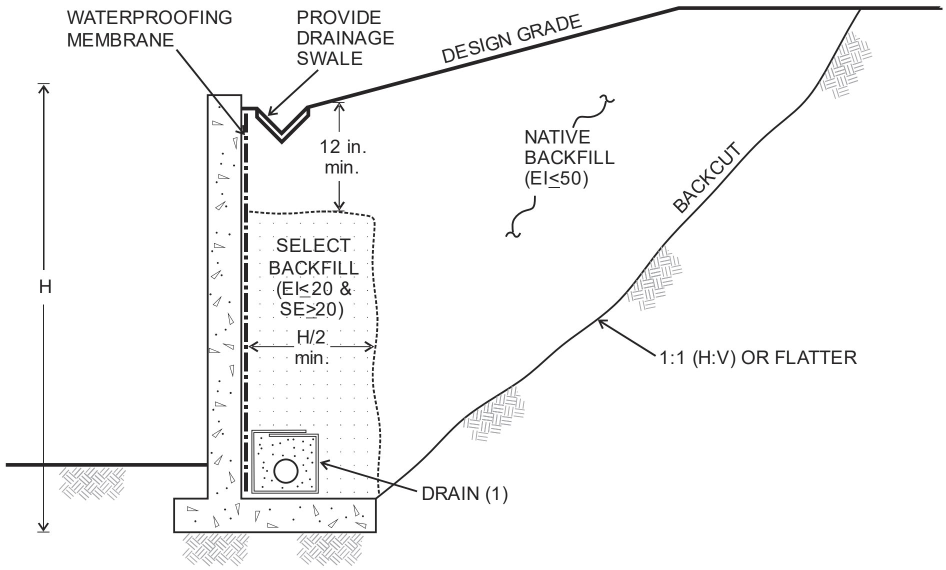
Where:

- Pe = Seismic thrust load
- H = Height of the wall (feet)
- γ = soil density = 130 pounds per cubic foot (pcf)
- k_h = seismic pseudostatic coefficient = 0.5 * PGA_M

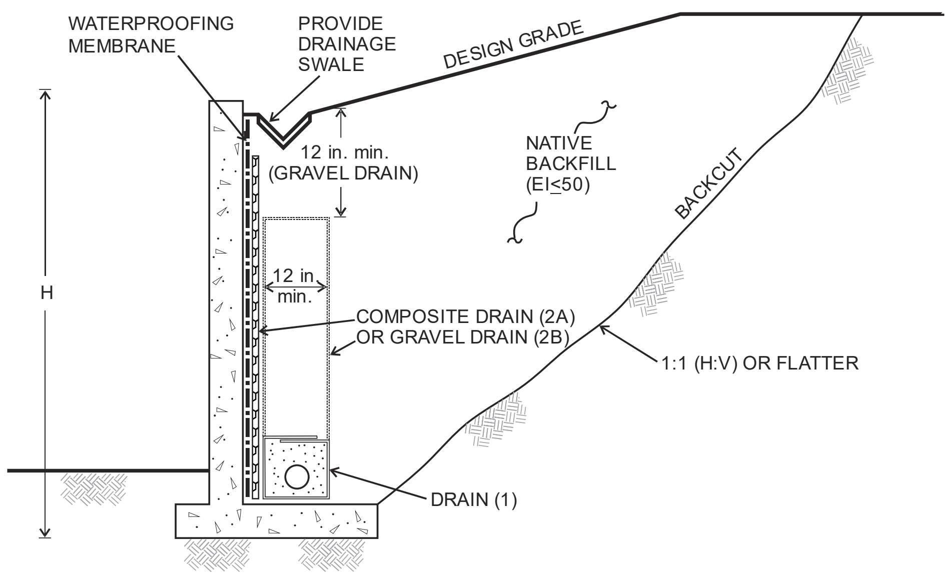
The peak horizontal ground accelerations are provided in Section 5.7.3. Walls should be designed to resist the combined effects of static pressures and the above seismic thrust load.

Retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces as shown in Details RTW-A and RTW-B. Otherwise, the retaining walls should be designed to resist hydrostatic forces. Proper drainage devices should be installed along the top of the wall backfill and should be properly sloped to prevent surface water ponding adjacent to the wall. In addition to the wall drainage system, for building perimeter walls extending below the finished grade, the wall should be waterproofed and/or damp-proofed to effectively seal the wall from moisture infiltration through the wall section to the interior wall face.

The wall should be backfilled with granular soils placed in loose lifts no greater than 8 inches thick, at or near optimum moisture content, and mechanically compacted to a minimum 90 percent of the maximum dry density as determined by ASTM D1557. Flooding or jetting of backfill materials generally do not result in the required degree and uniformity of compaction and, therefore, is not recommended. No backfill should be placed against concrete until minimum design strengths are achieved as verified by compression tests of cylinders. The geotechnical consultant should observe the retaining wall footings, back drain installation, and be present during placement of the wall backfill to confirm that the walls are properly backfilled and compacted.



Detail RTW-A



Detail RTW-B

NOTES: (1) DRAIN: 4-INCH PERFORATED ABS OR PVC PIPE OR APPROVED EQUIVALENT SUBSTITUTE PLACED PERFORATIONS DOWN AND SURROUNDED BY A MINIMUM OF 1 CUBIC FEET OF 3/4 INCH ROCK OR APPROVED EQUIVALENT SUBSTITUTE AND WRAPPED IN MIRAFI 140 FILTER FABRIC OR APPROVED EQUIVALENT SUBSTITUTE

(2A) COMPOSITE DRAIN SYSTEM: MIRAFI G200N, DELTA DRAIN 2000/6000/6200 OR APPROVED EQUIVALENT SUBSTITUTE CONNECTED TO DRAIN (1)

(2B) GRAVEL DRAIN: MINIMUM 12-INCH WIDE 3/4-INCH GRAVEL BLANKET WRAPPED IN MIRAFI FILTER FABRIC (140 OR APPROVED EQUIVALENT SUBSTITUTE)

FIGURE 8.1.3
Retaining Wall Backfill and Drainage Details

8.2. Soldier Pile and Lagging Wall

As an alternative to a conventional retaining wall, a soldier pile and lagging wall could be constructed along the eastern boundary of the site. For design of cantilevered shoring, a triangular distribution of lateral earth pressure based on an equivalent fluid pressure of 38 pcf is recommended. It is assumed that the backfill soils are drained and that a level surface exists behind the cantilevered shoring.

The wall should be designed to resist any adjacent surcharges (live and dead loads) located within a 1:1 (horizontal:vertical) plane drawn up from the base of the shoring.

For design of soldier piles embedded in old alluvial deposits, an allowable passive pressure of 350 psf per foot of embedment over three times the pile diameter or the spacing of the piles, whichever is less, up to a maximum of 7,500 psf can be used. Soldier piles should be spaced at least three pile diameters, center to center.

Caving soils may be encountered between the piles and may be supported by lagging or guniting. All lumber left in the ground should be treated in accordance with Section 204-2 of the "2018 Standard Specifications for Public Works Construction".

Movement of the areas adjacent to the shoring should be evaluated during construction. The areas surrounding the excavation should be surveyed and the condition of the existing improvements should be photo/video-documented prior to construction. It is recommended that survey monuments should be installed within a 1½:1 projection of the bottom of any vertical cut, at the top of the soldier pile/sheet pile and bottom of the pile at the base of the excavation. Monitoring points should be surveyed weekly during construction. To reduce the potential for distress to adjacent structures, we recommend that the shoring system be designed to limit ground settlement behind the shoring system to 1/2 inch or less. In areas where no settlement sensitive improvements are present, a deflection limit of 1 inch may be used. If deflections reach ¼ inch, the geotechnical engineer and shoring design engineer should be notified to evaluate and provide additional recommendations, if needed.

8.3. Civil Design Recommendations

8.3.1. Site Drainage

Final site grading should assure positive drainage away from structures. Planter areas should be provided with area drains to transmit irrigation and rainwater away from structures. The use of gutters and down spouts to carry roof drainage well away from structures is recommended. Raised planters should be provided with a positive means to remove water through the face of the containment wall.

8.3.2. Rear and Side Yard Walls and Fences

Block wall footings should be founded a minimum of 24-inches below the lowest adjacent grade. To reduce the potential for uncontrolled, unsightly cracks, it is recommended that a construction joint be incorporated at regular intervals. Spacing of the joints should be between 10 and 20 feet.

8.3.3. Exterior Flatwork

8.3.3.1. *Slab Thickness*

Concrete flatwork should be designed utilizing 4-inch minimum thickness.

8.3.3.2. *Control Joints*

Weakened plane joints should be installed on walkways at intervals of approximately 6 to 8 feet. Exterior slabs should be designed to withstand shrinkage of the concrete.

8.3.3.3. *Flatwork Reinforcement*

Consideration should be given to reinforcing any exterior flatwork.

8.3.3.4. *Thickened Edge*

Consideration should be given to construct a thickened edge (scoop footing) at the perimeter of slabs and walkways adjacent to landscape areas to minimize moisture variation below these improvements. The thickened edge (scoop footing) should extend approximately 8 inches below concrete slabs and should be a minimum of 6 inches wide.

8.3.4. Pavement Design

Preliminary pavement recommendations for streets and driveways are provided below. The performance of pavement is highly dependent on providing positive surface drainage away from the edge of pavement. Ponding of water on or adjacent to the pavement will likely result in pavement distress and subgrade failure. Drainage from landscaped areas should be directed towards controlled drainage structures and not towards pavement areas. Landscaped areas adjacent to pavement areas are not recommended due the potential for surface or irrigation water infiltrating into the aggregate base and pavement subgrade. If landscaped areas are placed adjacent to pavement areas, consideration should be given to implementing measures that will reduce the potential for water to be introduced into the aggregate base. Such measures may include installing impermeable vertical barriers between the landscaped area and pavement areas including deepened curbs or 10 mil thick plastic liners extending a minimum of 6 inches below the bottom of the aggregate base.

8.3.4.1. *Asphalt Concrete Pavement*

Presented below are preliminary pavement sections for a range of traffic indices and assumed R-Value of 30 for the subgrade soils. R-Value testing of the subgrade soils should be performed during precise grading operations. Final pavement structural sections will be dependent on the R-value of the subgrade materials and the traffic index for the specific street or area being addressed. The pavement sections are subject to review and approval by the County of Riverside.

TABLE 8.2.4.1
PRELIMINARY ASPHALT CONCRETE PAVEMENT SECTIONS*

Traffic Index	Assumed R-Value	Asphalt Concrete (inches)	Class II Aggregate Base (inches)
4.5	30	3	5
5.0	30	3	6
5.5	30	3	7
6.0	30	3.5	8
6.5	30	4	8
*Note: See additional recommendations for subgrade preparation below.			

Pavement subgrade soils should be at or near optimum moisture content and should be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557. Aggregate base should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D1557 and should conform with the specifications listed in Section 26 of the *Standard Specifications for the State of California Department of Transportation* (Caltrans) or Section 200-2 of the *Standard Specifications for Public Works Construction* (Green Book). The asphalt concrete should conform to Section 26 of the Caltrans *Standard Specifications* or Section 203-6 of the Green Book.

8.4. Corrosion

Resistivity and pH tests should be conducted during grading to evaluate the corrosivity of fill to buried metallic materials. AGS recommends minimally that the current standard of care be employed for protection of metallic construction materials in contact with onsite soils or that consultation with an engineer specializing in corrosion to determine specifications for protection of the construction materials.

9.0 SLOPE AND LOT MAINTENANCE

Maintenance of improvements is essential to the long-term performance of structures and slopes. Although the design and construction during mass grading created slopes that are considered both grossly and surficially stable, certain factors are beyond the control of the soil engineer and geologist. The homeowners must implement certain maintenance procedures.

In addition to the appended Homeowners Maintenance Guidelines, the following recommendations should be implemented.

9.1. Slope Planting

Slope planting should consist of ground cover, shrubs and trees that possess deep, dense root structures and require a minimum of irrigation. The resident should be advised of their responsibility to maintain such planting.

9.2. Lot Drainage

Roof, pad and lot drainage should be collected and directed away from structures and slopes and toward approved disposal areas. Design fine-grade elevations should be maintained through the life of the structure, or if design fine grade elevations are altered, adequate area drains should be installed in order to provide rapid discharge of water away from structures and slopes. Residents should be made aware that they are responsible for maintenance and cleaning of all drainage terraces, downdrains, and other devices that have been installed to promote structure and slope stability.

9.3. Slope Irrigation

The resident, homeowner and Homeowner Association should be advised of their responsibility to maintain irrigation systems. Leaks should be repaired immediately. Sprinklers should be adjusted to provide maximum uniform coverage with a minimum of water usage and overlap. Overwatering with consequent wasteful run-off and ground saturation should be avoided. If automatic sprinkler systems are installed, their use must be adjusted to account for natural rainfall conditions.

9.4. Burrowing Animals

Residents or homeowners should undertake a program for the elimination of burrowing animals. This should be an ongoing program in order to maintain slope stability.

10.0 FUTURE STUDY NEEDS

10.1. Future Geotechnical Studies

Design plans have not yet been developed. The recommendations provided herein are considered preliminary and subject to change based on the actual design. When available, the Geotechnical Consultant of Record should review detailed construction plans. The following plans should be reviewed:

- Foundation Plans, including wall plans and calculations;
- Precise Grading Plans;
- Temporary Shoring Plans and Calculations, if proposed.

10.2. Grading Observation

Geologic exposures afforded during remedial and rough grading operations provide the best opportunity to evaluate the anticipated site geologic structure. Continuous geologic and geotechnical observations, testing, and mapping should be provided throughout site development. Additional near-surface samples should be collected by the geotechnical consultant during grading and subjected to laboratory testing. Final design recommendations should be provided in a grading report based on the observation and test results collected during grading.

11.0 CLOSURE

11.1. Geotechnical Review

As is the case in any grading project, multiple working hypotheses are established utilizing the available data, and the most probable model is used for the analysis. Some of the assumptions summarized herein may need to be changed as more information becomes available during grading. Modification of the grading and construction recommendations may be necessary, if field conditions differ significantly from those assumed in this report.

AGS should review the pertinent plans and sections of the project specifications, to evaluate conformance with the intent of the recommendations contained in this report. If the project description or final design varies from that described in this report, AGS must be consulted regarding the applicability of, and the necessity for, any revisions to the recommendations presented herein. AGS accepts no liability for any use of its recommendations if the project description or final design varies and AGS is not consulted regarding the changes.

11.2. Limitations

This report is based on the project as described and the information obtained from referenced reports and the exploratory excavations at the locations indicated on the plans. The findings are based on the review of the field and laboratory data combined with an interpolation and extrapolation of conditions between and beyond the exploratory excavations. The results reflect an interpretation of the direct evidence obtained. Services performed by AGS have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, either expressed or implied, and no warranty or guarantee is included or intended.

The recommendations presented in this report are based on the assumption that an appropriate level of field review will be provided by geotechnical engineers and engineering geologists who are familiar with the design and site geologic conditions. That field review shall be sufficient to confirm that geotechnical and geologic conditions exposed during grading are consistent with the geologic representations and corresponding recommendations presented in this report. AGS should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations of this report are applicable to the specific design of this project as discussed in this report. They have no applicability to any other project or to any other location, and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of AGS.

AGS has no responsibility for construction means, methods, techniques, sequences, or procedures, or for safety precautions or programs in connection with the construction, for the acts or omissions of the CONTRACTOR, or any other person performing any of the construction, or for the failure of any of them to carry out the construction in accordance with the final design drawings and specifications.

APPENDIX A

REFERENCES

APPENDIX A

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APPENDIX B

SUBSURFACE LOGS AND LABORATORY RESULTS BY OTHERS

(SSI 2005)

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-1

Project: Victoria Homes / Tr.32989		**Job No.:**	05156-F
Logged By: John	**Boring Diam.:** 8"	**Date:**	29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
	Bulk/Grab						0	Weeds
					SP-SM			Sand - Lt brn, silty, dry, fine to med., pebbles, slighlty porous (Max 133 pcf @ 9.0%)
							2	
	California	4.0	107	80				
							4	
7	SPT							
					SP		6	- Lt brn, slightly silty, fine to med. coarse, pebbles, rock frag., slightly porous
							8	
	California	4.5	120	90				
							10	
20	SPT							- Lt brn, slightly silty, fine to med., pebbles
							12	

Groundwater: None **Approx. Depth of Bedrock:** None **Datum:** N/A **Elevation:** N/A	**Site Location** NEC Center & Mt Vernon Riverside County	**Plate #**

Bulk/Grab sample   California sampler   Standard penetration test

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-1

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
							14	
25								
							16	
							18	
							20	
27								- Yellow brn, fine to med. coarse, rock frag.
							22	
							24	
23								
							26	
							28	
								- Lt brn, fine to med. coarse, pebbles,

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897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-1

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
								rock frag.
							30	
24								
								- End of boring @ 31' No bedrock No groundwater
							32	
							34	
							36	
							38	
							40	
							42	
							44	

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-2

Project: Victoria Homes / Tr.32989 **Job No.:** 05156-F
Logged By: John **Boring Diam.:** 8" **Date:** 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
					SP			Weeds
								Sand - Brn, dry, fine to med., pebbles, slighlty porous, slightly silty
							2	
10	Standard penetration test							
							4	
	California sampler	8.0	117	88				
							6	
							8	
27	Standard penetration test							
							10	
							12	
								- Lt brn, fine to med. coarse, pebbles, rock frag.
12	Standard penetration test							

Groundwater: None
Approx. Depth of Bedrock: None
Datum: N/A
Elevation: N/A

Site Location
NEC Center & Mt Vernon
Riverside County

Plate #

Bulk/Grab sample   California sampler   Standard penetration test

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-2

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
							14	
							15	- Lt brn, med. to coarse
							16	
							18	
25								
					SP-SM		19	- Lt brn, silty, fine to med., pebbles
							20	
								- End of boring @ 20' No bedrock No groundwater
							22	
							24	
							26	
							28	

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-3

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
					SP			Weeds
								Sand - Brn, slightly silty, dry, fine to med., pebbles, slightly porous
							2	
							4	
18	Standard penetration test							
							6	
							8	
16	Standard penetration test							- Scattered rock 1", moist
							10	
							12	

Groundwater: None Approx. Depth of Bedrock: None Datum: N/A Elevation: N/A	**Site Location** NEC Center & Mt Vernon Riverside County	**Plate #**

Bulk/Grab sample · California sampler · Standard penetration test

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-3

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
							14	
27					SP-SM			- Lt brn, silty, moist, fine to med., coarse, pebbles, rock frag.
							16	- End of boring @ 16' No bedrock No groundwater
							18	
							20	
							22	
							24	
							26	
							28	

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-4

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
					SP			Weeds
								Sand - Brn, slightly silty, dry, fine to med., pebbles, slighlty porous
							2	
3	Standard penetration test							- Very loose
							4	
							6	
					SP-SM			- Brn, silty, fine to med. coarse, moist
6	Standard penetration test							
							8	
					SP			- Gray brn, fine to med. coarse, rock frag., pebbles, moist, slightly silty
							10	
	California sampler	8.0	126	95				
							12	

Groundwater: None Approx. Depth of Bedrock: None Datum: N/A Elevation: N/A	Site Location NEC Center & Mt Vernon Riverside County	Plate #

Bulk/Grab sample   California sampler   Standard penetration test

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-4

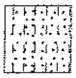
Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

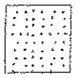
Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
							14	- Lt brn, slightly silty, fine to med. coarse, pebbles, rock frag.
27								
							16	
								- End of boring @ 16' No bedrock No groundwater
							18	
							20	
							22	
							24	
							26	
							28	

KEY TO SYMBOLS

Symbol Description

Strata symbols

 Poorly graded sand with silt

 Poorly graded sand

Soil Samplers

 Bulk/Grab sample

 California sampler

 Standard penetration test

Notes:

1. Exploratory borings were drilled on 29 Jun 05 using a 4-inch diameter continuous flight power auger.
2. No free water was encountered at the time of drilling or when re-checked the following day.
3. Boring locations were taped from existing features and elevations extrapolated from the final design schematic plan.
4. These logs are subject to the limitations, conclusions, and recommendations in this report.
5. Results of tests conducted on samples recovered are reported on the logs.

8.0 APPENDIX B

Laboratory Test Programs

Laboratory tests were conducted on representative soils for the purpose of classification and for the determination of the physical properties and engineering characteristics. The number and selection of the types of testing for a given study are based on the geotechnical conditions of the site. A summary of the various laboratory tests performed for the project is presented below.

Moisture Content and Dry Density (D2937):

Data obtained from these test, performed on undisturbed samples are used to aid in the classification and correlation of the soils and to provide qualitative information regarding soil strength and compressibility.

Direct Shear (D3080):

Data obtained from this test performed at increased and field moisture conditions on relatively remolded soil sample is used to evaluate soil shear strengths. Samples contained in brass sampler rings, placed directly on test apparatus are sheared at a constant strain rate of 0.002 inch per minute under saturated conditions and under varying loads appropriate to represent anticipated structural loadings. Shearing deformations are recorded to failure. Peak and/or residual shear strengths are obtained from the measured shearing load versus deflection curve. Test results, plotted on graphical form, are presented on Plate B-1 of this section.

Consolidation (D2835):

Drive-tube samples are tested at their field moisture contents and at increased moisture conditions since the soils may become saturated during life-time use of the planned structure.

Data obtained from this test performed on relatively undisturbed and/or remolded samples, were used to evaluate the consolidation characteristics of foundation soils under anticipated foundation loadings. Preparation for this test involved trimming the sample, placing it in one inch high brass ring, and loading it into the test apparatus which contained porous stones to accommodate drainage during testing. Normal axial loads are applied at a load increment ratio, successive loads being generally twice the preceding.

Soil samples are usually under light normal load conditions to accommodate seating of the apparatus. Samples were tested at the field moisture conditions at a predetermined normal load. Potentially moisture sensitive soil typically demonstrated significant volume change with the introduction of free water. The results of the consolidation tests are presented in graphical forms on Plate B-2.

Potential Expansion

Considering sandy nature, the site soils are considered non-expansive in contact with water, and consequently, no expansion tests are performed and none such are considered necessary at this time.

Laboratory Test Results

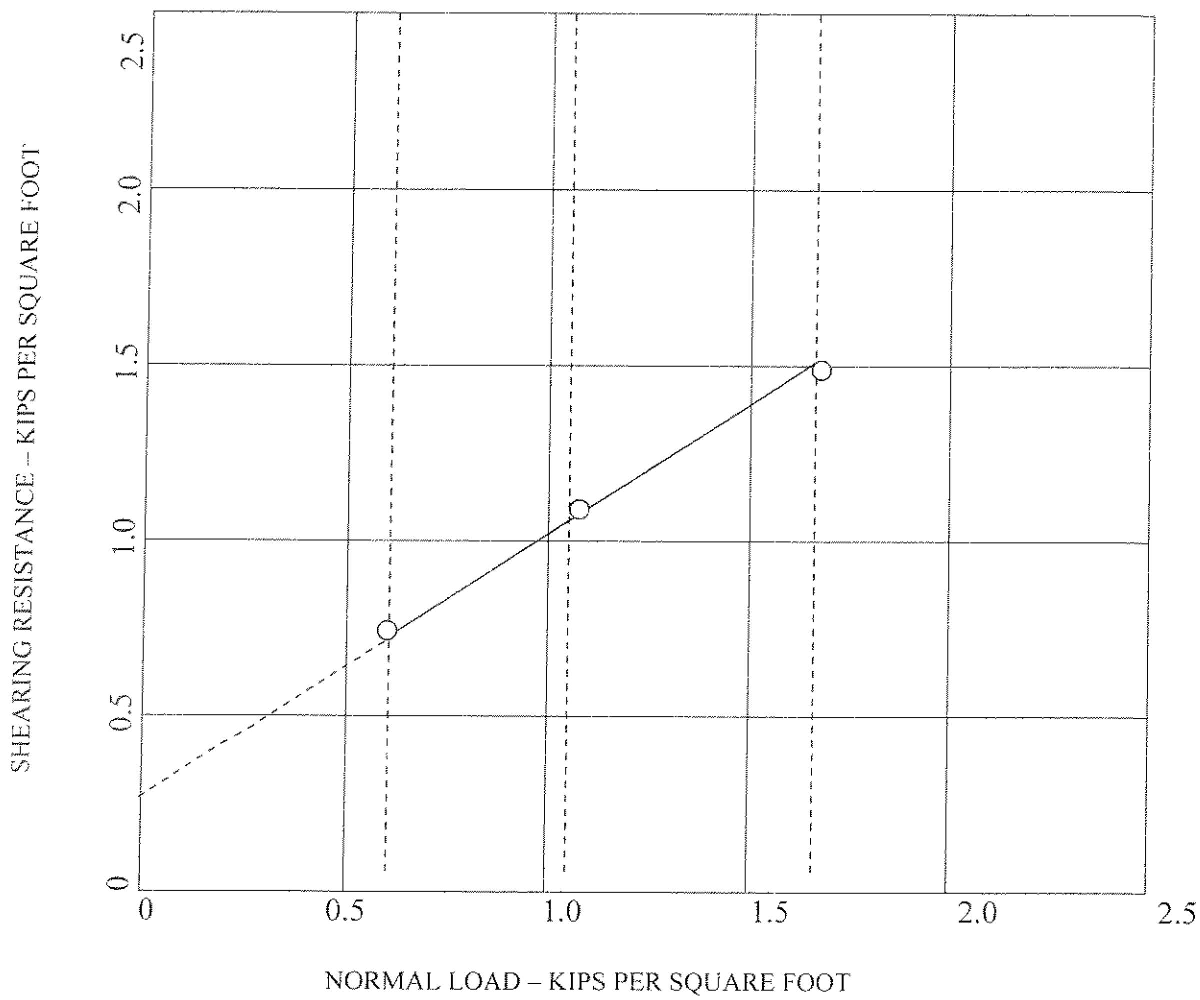
Table I: In-Situ Moisture-Density

Test Boring No.	Sample Depth, ft.	Dry Density, pcf.	Moisture Content, %
1	3.0	107	4.0
1	8.0	120	4.5
2	5.0	117	8.0
4	10.0	126	8.0

Table III: Max. Density/Optimum Moisture Content (ASTM D1557-91)

Sample Location, @ Depth, ft.	Max. Dry Density, pcf	Opt. Moisture (%)
B-1 @ 0-3	133	9.0

DIRECT SHEAR TESTS

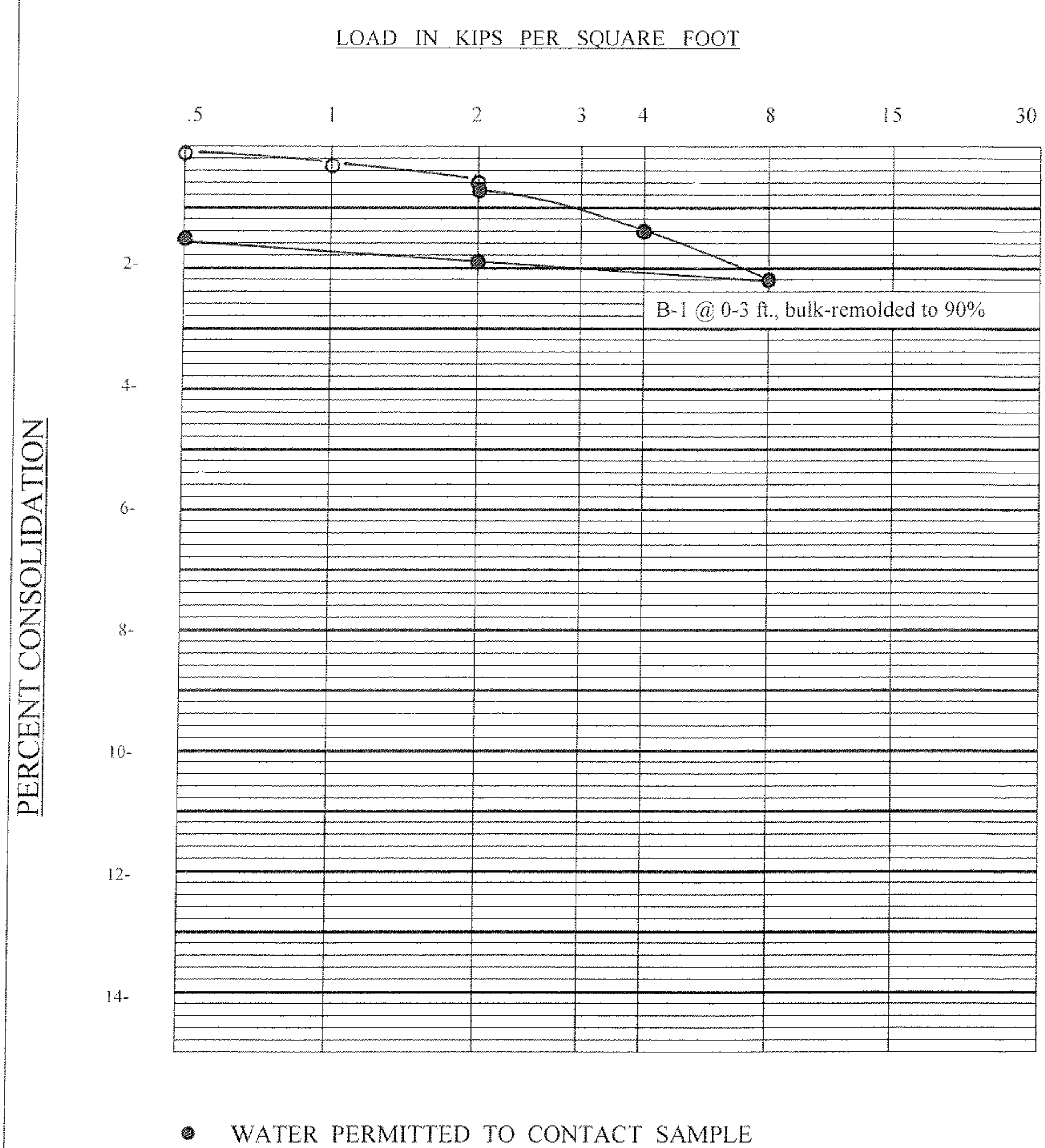


SYMBOL	LOCATION	DEPTH (ft)	TEST CONDITION	COHESION (psf)	FRICTION (degree)
○	B-1	0-3	Bulk-remolded to 90%	275	33

Proposed Single Family Tract 32989 NEC Center Street & Mt Vernon Avenue Highgrove area, Riverside County, California	PROJECT NO.	05156-F
	PLATE	B-1

SOILS SOUTHWEST INC.
Consulting Foundation Engineers

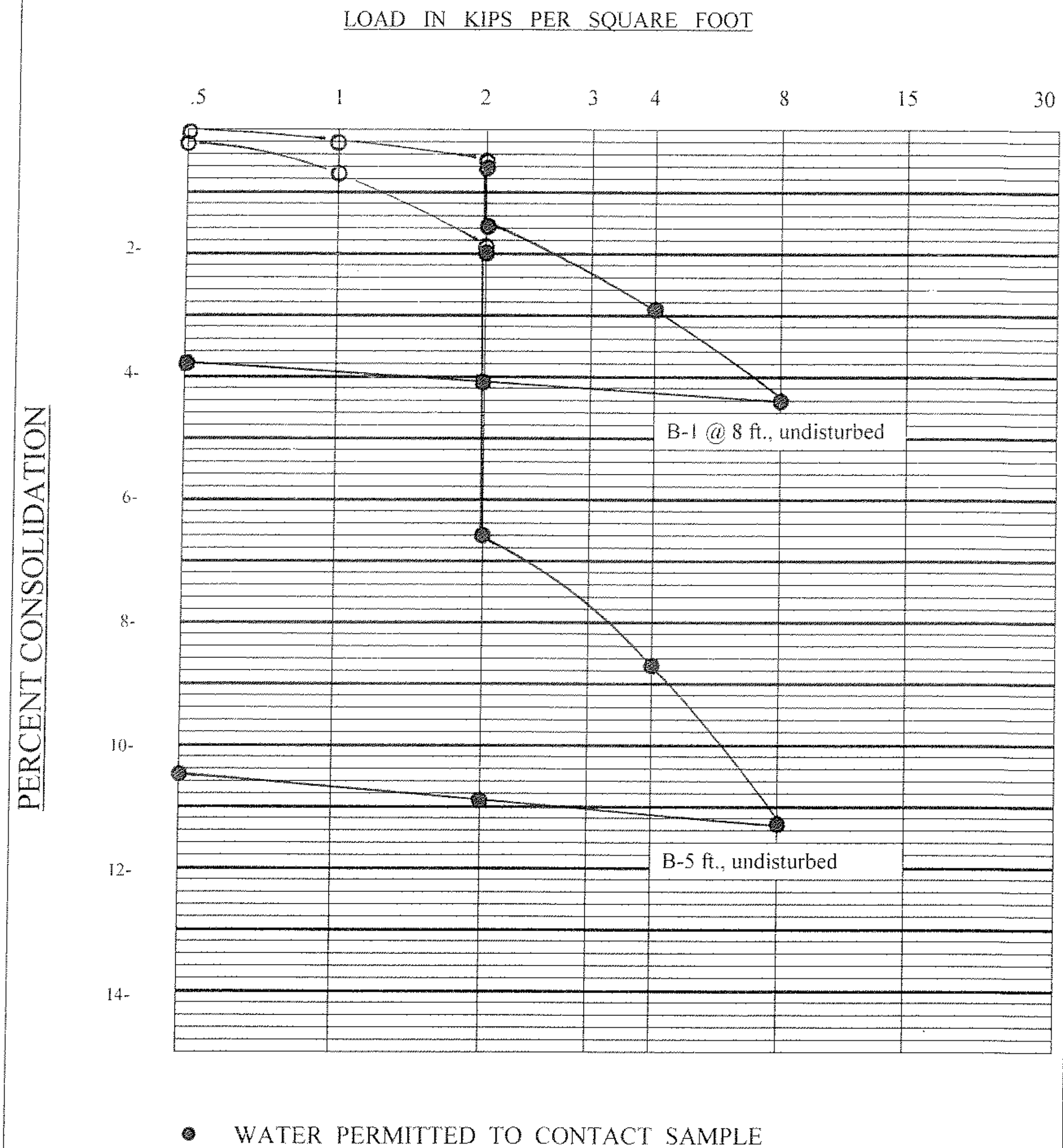
CONSOLIDATION TESTS



Proposed Single Family Tract 32989 NEC Center Street & Mt Vernon Avenue Highgrove area, Riverside County, California	PROJECT NO.	05156-F
	PLATE	B-2

SOILS SOUTHWEST INC.
Consulting Foundation Engineers

CONSOLIDATION TESTS



Proposed Single Family Tract 32989 NEC Center Street & Mt Vernon Avenue Highgrove area, Riverside County, California	PROJECT NO.	05156-F
	PLATE	B-2-1

SOILS SOUTHWEST INC.
Consulting Foundation Engineers

APPENDIX C

GENERAL EARTHWORK SPECIFICATIONS AND GRADING DETAILS

GENERAL EARTHWORK SPECIFICATIONS

I. General

A. General procedures and requirements for earthwork and grading are presented herein. The earthwork and grading recommendations provided in the geotechnical report are considered part of these specifications, and where the general specifications provided herein conflict with those provided in the geotechnical report, the recommendations in the geotechnical report shall govern. Recommendations provided herein and in the geotechnical report may need to be modified depending on the conditions encountered during grading.

B. The contractor is responsible for the satisfactory completion of all earthwork in accordance with the project plans, specifications, applicable building codes, and local governing agency requirements. Where these requirements conflict, the stricter requirements shall govern.

C. It is the contractor's responsibility to read and understand the guidelines presented herein and in the geotechnical report as well as the project plans and specifications. Information presented in the geotechnical report is subject to verification during grading. The information presented on the exploration logs depict conditions at the particular time of excavation and at the location of the excavation. Subsurface conditions present at other locations may differ, and the passage of time may result in different subsurface conditions being encountered at the locations of the exploratory excavations. The contractor shall perform an independent investigation and evaluate the nature of the surface and subsurface conditions to be encountered and the procedures and equipment to be used in performing his work.

D. The contractor shall have the responsibility to provide adequate equipment and procedures to accomplish the earthwork in accordance with applicable requirements. When the quality of work is less than that required, the Geotechnical Consultant may reject the work and may recommend that the operations be suspended until the conditions are corrected.

E. Prior to the start of grading, a qualified Geotechnical Consultant should be employed to observe grading procedures and provide testing of the fills for conformance with the project specifications, approved grading plan, and guidelines presented herein. All clearing and grubbing, remedial removals, clean-outs, removal bottoms, keyways, and subdrain installations should be observed and documented by the Geotechnical Consultant prior to placing fill. It is the contractor's responsibility to apprise the Geotechnical Consultant of their schedules and notify the Geotechnical Consultant when those areas are ready for observation.

F. The contractor is responsible for providing a safe environment for the Geotechnical Consultant to observe grading and conduct tests.

II. Site Preparation

A. Clearing and Grubbing: Excessive vegetation and other deleterious material shall be sufficiently removed as required by the Geotechnical Consultant, and such materials shall be properly disposed of offsite in a method acceptable to the owner and governing agencies. Where applicable, the contractor may obtain permission from the Geotechnical Consultant, owner, and governing agencies to dispose of vegetation and other deleterious materials in designated areas onsite.

B. Unsuitable Soils Removals: Earth materials that are deemed unsuitable for the support of fill shall be removed as necessary to the satisfaction of the Geotechnical Consultant.

C. Any underground structures such as cesspoles, cisterns, mining shafts, tunnels, septic tanks, wells, pipelines, other utilities, or other structures located within the limits of grading shall be removed and/or abandoned in accordance with the requirements of the governing agency and to the satisfaction of the Geotechnical Consultant. Environmental evaluation of existing conditions is not the responsibility of the Geotechnical Consultant.

D. Preparation of Areas to Receive Fill: After removals are completed, the exposed surfaces shall be processed or scarified to a depth of approximately 8 inches, watered or dried, as needed, to achieve a generally uniform moisture content that is at or near optimum moisture content. The scarified materials shall then be compacted to the project requirements and tested as specified.

E. All areas receiving fill shall be observed and approved by the Geotechnical Consultant prior to the placement of fill. A licensed surveyor shall provide survey control for determining elevations of processed areas and keyways.

III. Placement of Fill

A. Suitability of fill materials: Any materials, derived onsite or imported, may be utilized as fill provided that the materials have been determined to be suitable by the Geotechnical Consultant. Such materials shall be essentially free of organic matter and other deleterious materials, and be of a gradation, expansion potential, and/or strength that is acceptable to the Geotechnical Consultant. Fill materials shall be tested in a laboratory approved by the Geotechnical Consultant, and import materials shall be tested and approved prior to being imported.

B. Generally, different fill materials shall be thoroughly mixed to provide a relatively uniform blend of materials and prevent abrupt changes in material type. Fill materials derived from benching should be dispersed throughout the fill area instead of placing the materials within only an equipment-width from the cut/fill contact.

C. Oversize Materials: Rocks greater than 12 inches in largest dimension shall be disposed of offsite or be placed in accordance with the recommendations by the Geotechnical Consultant in the areas that are designated as suitable for oversize rock placement. Rocks that are smaller than 8 inches in largest dimension may be utilized in the fill provided that they are not nested and are their quantity and distribution are acceptable to the Geotechnical Consultant and do not inhibit the ability to properly compact fill materials.

D. The fill materials shall be placed in thin, horizontal layers such that, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and shall be thoroughly mixed to obtain a near uniform moisture content and uniform blend of materials.

E. Moisture Content: Fill materials shall be placed at or above the optimum moisture content or as recommended by the geotechnical report. Where the moisture content of the engineered fill is less than recommended, water shall be added, and the fill materials shall be blended so that a near uniform moisture content is achieved. If the moisture content is above the limits specified by the Geotechnical Consultant, the fill materials shall be aerated by discing, blading, or other methods until the moisture content is acceptable.

F. Each layer of fill shall be compacted to the project standards in accordance to the project specifications and recommendations of the Geotechnical Consultant. Unless otherwise specified by the Geotechnical Consultant, the fill shall be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM Test Method: D1557.

G. Benching: Where placing fill on a slope exceeding a ratio of 5 to 1 (horizontal to vertical), the ground should be keyed or benched. The keyways and benches shall extend through all unsuitable materials into suitable materials such as firm materials or sound bedrock or as recommended by the Geotechnical Consultant. The minimum keyway width shall be 15 feet and extend into suitable materials, or as recommended by the geotechnical report and approved by the Geotechnical Consultant. The minimum keyway width for fill over cut slopes is also 15 feet, or as recommended by the geotechnical report and approved by the Geotechnical Consultant. As a general rule, unless otherwise recommended by the Geotechnical Consultant, the minimum width of the keyway shall be equal to ½ the height of the fill slope.

H. Slope Face: The specified minimum relative compaction shall be maintained out to the finish face of fill and stabilization fill slopes. Generally, this may be achieved by overbuilding the slope and cutting back to the compacted core. The actual amount of overbuilding may vary as field conditions dictate. Alternately, this may be achieved by backrolling the slope face with suitable equipment or other methods that produce the designated result. Loose soil should not be allowed to build up on the slope face. If present, loose soils shall be trimmed to expose the compacted slope face.

I. Slope Ratio: Unless otherwise approved by the Geotechnical Consultant and governing agencies, permanent fill slopes shall be designed and constructed no steeper than 2 to 1 (horizontal to vertical).

J. Natural Ground and Cut Areas: Design grades that are in natural ground or in cuts should be evaluated by the Geotechnical Consultant to determine whether scarification and processing of the ground and/or overexcavation is needed.

K. Fill materials shall not be placed, spread, or compacted during unfavorable weather conditions. When grading is interrupted by rain, filing operations shall not resume until the Geotechnical Consultant approves the moisture and density of the previously placed compacted fill.

IV. Cut Slopes

A. The Geotechnical Consultant shall observe all cut slopes, including fill over cut slopes, and shall be notified by the contractor when cut slopes are started.

B. If adverse or potentially adverse conditions are encountered during grading, the Geotechnical Consultant shall investigate, evaluate, and make recommendations to mitigate the adverse conditions.

C. Unless otherwise stated in the geotechnical report, cut slopes shall not be excavated higher or steeper than the requirements of the local governing agencies. Short-term stability of the cut slopes and other excavations is the contractor's responsibility.

V. Drainage

A. Backdrains and Subdrains: Backdrains and subdrains shall be provided in fill as recommended by the Geotechnical Consultant and shall be constructed in accordance with the governing agency and/or recommendations of the Geotechnical Consultant. The location of subdrains, especially outlets, shall be surveyed and recorded by the Civil Engineer.

B. Top-of-slope Drainage: Positive drainage shall be established away from the top of slope. Site drainage shall not be permitted to flow over the tops of slopes.

C. Drainage terraces shall be constructed in compliance with the governing agency requirements and/or in accordance with the recommendations of the Civil Engineer.

D. Non-erodible interceptor swales shall be placed at the top of cut slopes that face the same direction as the prevailing drainage.

VI. Erosion Control

A. All finish cut and fill slopes shall be protected from erosion and/or planted in accordance with the project specifications and/or landscape architect's recommendations. Such measures to protect the slope face shall be undertaken as soon as practical after completion of grading.

B. During construction, the contractor shall maintain proper drainage and prevent the ponding of water. The contractor shall take remedial measures to prevent the erosion of graded areas until permanent drainage and erosion control measures have been installed.

VII. Trench Excavation and Backfill

A. Safety: The contractor shall follow all OSHA requirements for safety of trench excavations. Knowing and following these requirements is the contractor's responsibility. All trench excavations or open cuts in excess of 5 feet in depth shall be shored or laid back. Trench excavations and open cuts exposing adverse geologic conditions may require further evaluation by the Geotechnical Consultant. If a contractor fails to provide safe access for compaction testing, backfill not tested due to safety concerns may be subject to removal.

B. Bedding: Bedding materials shall be non-expansive and have a Sand Equivalent greater than 30. Where permitted by the Geotechnical Consultant, the bedding materials can be densified by jetting.

C. Backfill: Jetting of backfill materials to achieve compaction is generally not acceptable. Where permitted by the Geotechnical Consultant, the bedding materials can be densified by jetting provided the backfill materials are granular, free-draining and have a Sand Equivalent greater than 30.

VIII. Geotechnical Observation and Testing During Grading

A. Compaction Testing: Fill will be tested and evaluated by the Geotechnical Consultant for evaluation of general compliance with the recommended compaction and moisture conditions. The tests shall be taken in the compacted soils beneath the surface if the surficial materials are disturbed. The contractor shall assist the Geotechnical Consultant by excavating suitable test pits for testing of compacted fill.

B. Where tests indicate that the density of a layer of fill is less than required, or the moisture content is not within specifications, the Geotechnical Consultant shall notify the contractor of the unsatisfactory conditions of the fill. The portions of the fill that are not within specifications shall be reworked until the required density and/or moisture content has been attained. No additional fill shall be placed until the last lift of fill is tested and found to meet the project specifications and approved by the Geotechnical Consultant.

C. If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as adverse weather, excessive rock or deleterious materials being placed in the fill, insufficient equipment, excessive rate of fill placement, results in a quality of work that is unacceptable, the consultant shall notify the contractor, and the contractor shall rectify the conditions, and if necessary, stop work until conditions are satisfactory.

D. Frequency of Compaction Testing: The location and frequency of tests shall be at the Geotechnical Consultant's discretion. Generally, compaction tests shall be taken at intervals approximately two feet in fill height.

E. Compaction Test Locations: The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of the compaction test locations. The contractor shall coordinate with the surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations. Alternately, the test locations can be surveyed and the results provided to the Geotechnical Consultant.

F. Areas of fill that have not been observed or tested by the Geotechnical Consultant may have to be removed and recompacted at the contractor's expense. The depth and extent of removals will be determined by the Geotechnical Consultant.

G. Observation and testing by the Geotechnical Consultant shall be conducted during grading in order for the Geotechnical Consultant to state that, in his opinion, grading has been completed in accordance with the approved geotechnical report and project specifications.

H. Reporting of Test Results: After completion of grading operations, the Geotechnical Consultant shall submit reports documenting their observations during construction and test results. These reports may be subject to review by the local governing agencies.

APPENDIX D

HOMEOWNERS MAINTENANCE GUIDELINES

HOMEOWNERS MAINTENANCE GUIDELINES

Homeowners are accustomed to maintaining their homes. They expect to paint their houses periodically, replace wiring, clean out clogged plumbing, and repair roofs. Maintenance of the home site, particularly on hillsides, should be considered on the same basis, or even on a more serious basis because neglect can result in serious consequences. In most cases, lot and site maintenance can be taken care of along with landscaping, and can be carried out more economically than repair after neglect.

Most slope and hillside lot problems are associated with water. Uncontrolled water from a broken pipe, cesspool, or wet weather causes most damage. Wet weather is the largest cause of slope problems, particularly in California where rain is intermittent, but may be torrential. Therefore, drainage and erosion control are the most important aspects of home site stability; these provisions must not be altered without competent professional advice. Further, maintenance must be carried out to assure their continued operation.

As geotechnical engineers concerned with the problems of building sites in hillside developments, we offer the following list of recommended home protection measures as a guide to homeowners.

Expansive Soils

Some of the earth materials on site have been identified as being expansive in nature. As such, these materials are susceptible to volume changes with variations in their moisture content. These soils will swell upon the introduction of water and shrink upon drying. The forces associated with these volume changes can have significant negative impacts (in the form of differential movement) on foundations, walkways, patios, and other lot improvements. In recognition of this, the project developer has constructed homes on these lots on post-tensioned or mat slabs with pier and grade beam foundation systems, intended to help reduce the potential adverse effects of these expansive materials on the residential structures within the project. Such foundation systems are not intended to offset the forces (and associated movement) related to expansive soil, but are intended to help soften their effects on the structures constructed thereon.

Homeowners purchasing property and living in an area containing expansive soils must assume a certain degree of responsibility for homeowner improvements as well as for maintaining conditions around their home. Provisions should be incorporated into the design and construction of homeowner improvements to account for the expansive nature of the onsite soils material. Lot maintenance and landscaping should also be conducted in consideration of the expansive soil characteristics. Of primary importance is minimizing the moisture variation below all lot improvements. Such design, construction and homeowner maintenance provisions should include:

- Employing contractors for homeowner improvements who design and build in recognition of local building code and site specific soils conditions.
- Establishing and maintaining positive drainage away from all foundations, walkways, driveways, patios, and other hardscape improvements.

- Avoiding the construction of planters adjacent to structural improvements. Alternatively, planter sides/bottoms can be sealed with an impermeable membrane and drained away from the improvements via subdrains into approved disposal areas.
- Sealing and maintaining construction/control joints within concrete slabs and walkways to reduce the potential for moisture infiltration into the subgrade soils.
- Utilizing landscaping schemes with vegetation that requires minimal watering. Alternatively, watering should be done in a uniform manner as equally as possible on all sides of the foundation, keeping the soil "moist" but not allowing the soil to become saturated.
- Maintaining positive drainage away from structures and providing roof gutters on all structures with downspouts installed to carry roof runoff directly into area drains or discharged well away from the structures.
- Avoiding the placement of trees closer to the proposed structures than a distance of one-half the mature height of the tree.
- Observation of the soil conditions around the perimeter of the structure during extremely hot/dry or unusually wet weather conditions so that modifications can be made in irrigation programs to maintain relatively constant moisture conditions.

Sulfates

On site soils were tested for the presence of soluble sulfates. Based on the results of that testing, the soluble sulfate exposure level was determined to be “negligible” to “severe” when classified in accordance with the ACI 318-05 Table 4.3.1 (per 2010 CBC). Concrete mixes should be designed based on Code standards.

Homeowners should be cautioned against the import and use of certain fertilizers, soil amendments, and/or other soils from offsite sources in the absence of specific information relating to their chemical composition. Some fertilizers have been known to leach sulfate compounds into soils otherwise containing “negligible” sulfate concentrations and increase the sulfate concentrations in near-surface soils to “moderate” or “severe” levels. In some cases, concrete improvements constructed in soils containing high levels of soluble sulfates may be affected by deterioration and loss of strength.

Water - Natural and Man Induced

Water in concert with the reaction of various natural and man-made elements, can cause detrimental effects to your structure and surrounding property. Rain water and flowing water erodes and saturates the ground and changes the engineering characteristics of the underlying earth materials upon saturation. Excessive irrigation in concert with a rainy period is commonly associated with shallow slope failures and deep seated landslides, saturation of near structure soils, local ponding of water, and transportation of water soluble substances that are deleterious to building materials including concrete, steel, wood, and stucco.

Water interacting with the near surface and subsurface soils can initiate several other potentially detrimental phenomena other then slope stability issues. These may include expansion/contraction cycles, liquefaction potential increase, hydro-collapse of soils, ground surface settlement, earth material consolidation, and introduction of deleterious substances.

The homeowners should be made aware of the potential problems which may develop when drainage is altered through construction of retaining walls, swimming pools, paved walkways and patios. Ponded water, drainage over the slope face, leaking irrigation systems, over-watering or other conditions which could lead to ground saturation must be avoided.

- Before the rainy season arrives, check and clear roof drains, gutters and down spouts of all accumulated debris. Roof gutters are an important element in your arsenal against rain damage. If you do not have roof gutters and down spouts, you may elect to install them. Roofs, with their, wide, flat area can shed tremendous quantities of water. Without gutters or other adequate drainage, water falling from the eaves collects against foundation and basement walls.
- Make sure to clear surface and terrace drainage ditches, and check them frequently during the rainy season. This task is a community responsibility.
- Test all drainage ditches for functioning outlet drains. This should be tested with a hose and done before the rainy season. All blockages should be removed.
- Check all drains at top of slopes to be sure they are clear and that water will not overflow the slope itself, causing erosion.
- Keep subsurface drain openings (weep-holes) clear of debris and other material which could block them in a storm.
- Check for loose fill above and below your property if you live on a slope or terrace.
- Monitor hoses and sprinklers. During the rainy season, little, if any, irrigation is required. Oversaturation of the ground is unnecessary, increases watering costs, and can cause subsurface drainage.
- Watch for water backup of drains inside the house and toilets during the rainy season, as this may indicate drain or sewer blockage.
- Never block terrace drains and brow ditches on slopes or at the tops of cut or fill slopes. These are designed to carry away runoff to a place where it can be safely distributed.
- Maintain the ground surface upslope of lined ditches to ensure that surface water is collected in the ditch and is not permitted to be trapped behind or under the lining.
- Do not permit water to collect or pond on your home site. Water gathering here will tend to either seep into the ground (loosening or expanding fill or natural ground), or will overflow into the slope and begin erosion. Once erosion is started, it is difficult to control and severe damage may result rather quickly.
- Never connect roof drains, gutters, or down spouts to subsurface drains. Rather, arrange them so that water either flows off your property in a specially designed pipe or flows out into a paved driveway or street. The water then may be dissipated over a wide surface or, preferably, may be carried away in a paved gutter or storm drain. Subdrains are constructed to take care of ordinary subsurface water and cannot handle the overload from roofs during a heavy rain.

- Never permit water to spill over slopes, even where this may seem to be a good way to prevent ponding. This tends to cause erosion and, in the case of fill slopes, can eat away carefully designed and constructed sites.
- Do not cast loose soil or debris over slopes. Loose soil soaks up water more readily than compacted fill. It is not compacted to the same strength as the slope itself and will tend to slide when laden with water; this may even affect the soil beneath the loose soil. The sliding may clog terrace drains below or may cause additional damage in weakening the slope. If you live below a slope, try to be sure that loose fill is not dumped above your property.
- Never discharge water into subsurface blanket drains close to slopes. Trench drains are sometimes used to get rid of excess water when other means of disposing of water are not readily available. Overloading these drains saturates the ground and, if located close to slopes, may cause slope failure in their vicinity.
- Do not discharge surface water into septic tanks or leaching fields. Not only are septic tanks constructed for a different purpose, but they will tend, because of their construction, to naturally accumulate additional water from the ground during a heavy rain. Overloading them artificially during the rainy season is bad for the same reason as subsurface subdrains, and is doubly dangerous since their overflow can pose a serious health hazard. In many areas, the use of septic tanks should be discontinued as soon as sewers are made available.
- Practice responsible irrigation practices and do not over-irrigate slopes. Naturally, ground cover of ice plant and other vegetation will require some moisture during the hot summer months, but during the wet season, irrigation can cause ice plant and other heavy ground cover to pull loose. This not only destroys the cover, but also starts serious erosion. In some areas, ice plant and other heavy cover can cause surface sloughing when saturated due to the increase in weight and weakening of the near-surface soil. Planted slopes should be planned where possible to acquire sufficient moisture when it rains.
- Do not let water gather against foundations, retaining walls, and basement walls. These walls are built to withstand the ordinary moisture in the ground and are, where necessary, accompanied by subdrains to carry off the excess. If water is permitted to pond against them, it may seep through the wall, causing dampness and leakage inside the basement. Further, it may cause the foundation to swell up, or the water pressure could cause structural damage to walls.
- Do not try to compact soil behind walls or in trenches by flooding with water. Not only is flooding the least efficient way of compacting fine-grained soil, but it could damage the wall foundation or saturate the subsoil.
- Never leave a hose and sprinkler running on or near a slope, particularly during the rainy season. This will enhance ground saturation which may cause damage.
- Never block ditches which have been graded around your house or the lot pad. These shallow ditches have been put there for the purpose of quickly removing water toward the driveway, street or other positive outlet. By all means, do not let water become ponded above slopes by blocked ditches.

- ❖ Seeding and planting of the slopes should be planned to achieve, as rapidly as possible, a well-established and deep-rooted vegetal cover requiring minimal watering.
- ❖ It should be the responsibility of the landscape architect to provide such plants initially and of the residents to maintain such planting. Alteration of such a planting scheme is at the resident's risk.
- ❖ The resident is responsible for proper irrigation and for maintenance and repair of properly installed irrigation systems. Leaks should be fixed immediately. Residents must undertake a program to eliminate burrowing animals. This must be an ongoing program in order to promote slope stability. The burrowing animal control program should be conducted by a licensed exterminator and/or landscape professional with expertise in hill side maintenance.

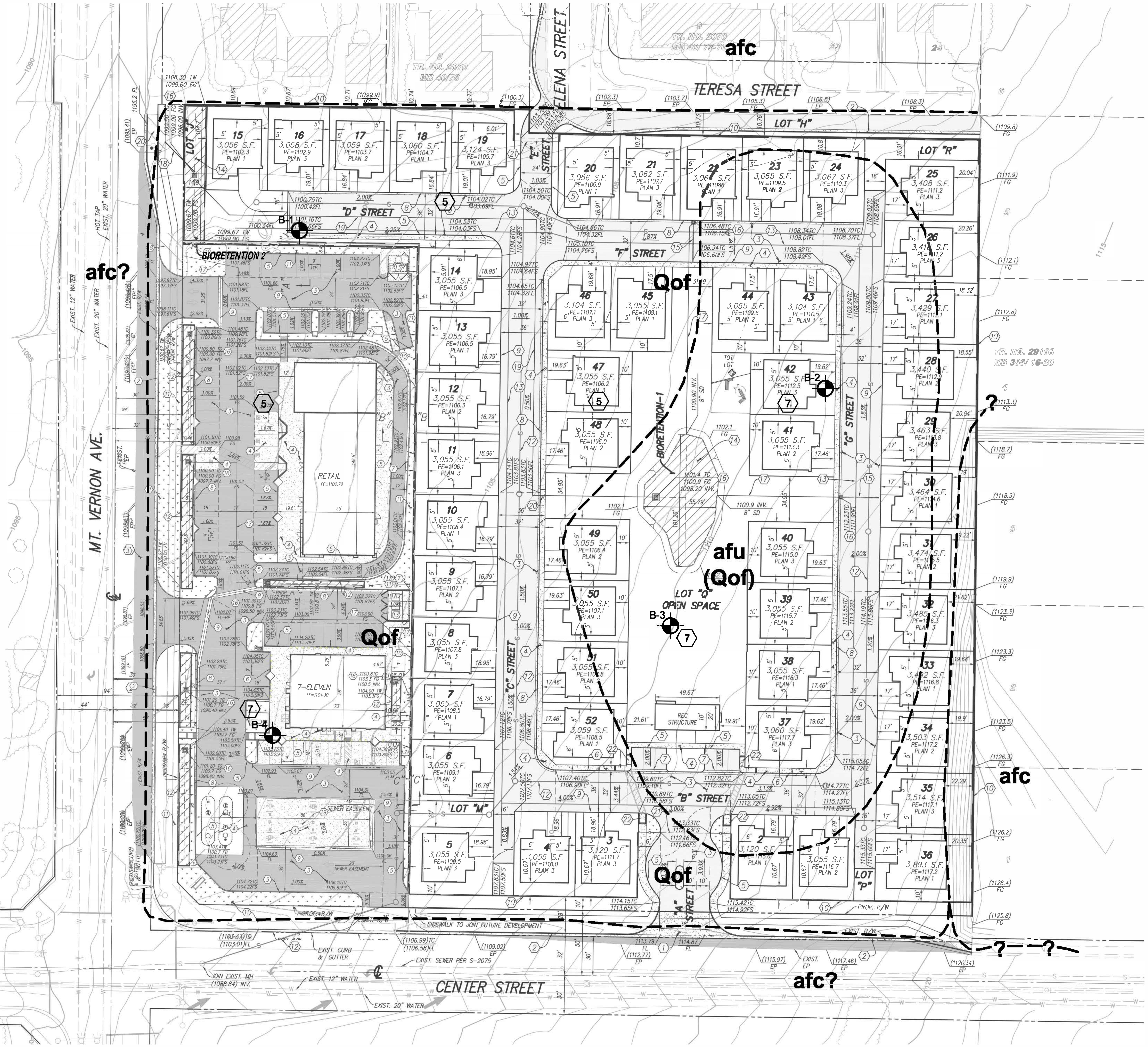
Geotechnical Review

Due to the presence of expansive soils on site and the fact that soil types may vary with depth, it is recommended that plans for the construction of rear yard improvements (swimming pools, spas, barbecue pits, patios, etc.), be reviewed by a geotechnical engineer who is familiar with local conditions and the current standard of practice in the vicinity of your home.

In conclusion, your neighbor’s slope, above or below your property, is as important to you as the slope that is within your property lines. For this reason, it is desirable to develop a cooperative attitude regarding hillside maintenance, and we recommend developing a “good neighbor” policy. Should conditions develop off your property, which are undesirable from indications given above, necessary action should be taken by you to insure that prompt remedial measures are taken. Landscaping of your property is important to enhance slope and foundation stability and to prevent erosion of the near surface soils. In addition, landscape improvements should provide for efficient drainage to a controlled discharge location downhill of residential improvements and soil slopes.

Additionally, recommendations contained in the Geotechnical Engineering Study report apply to all future residential site improvements, and we advise that you include consultation with a qualified professional in planning, design, and construction of any improvements. Such improvements include patios, swimming pools, decks, etc., as well as building structures and all changes in the site configuration requiring earth cut or fill construction.

CONCEPTUAL GRADING PLAN
TENTATIVE TRACT MAP 37743
APN: 255-150-001

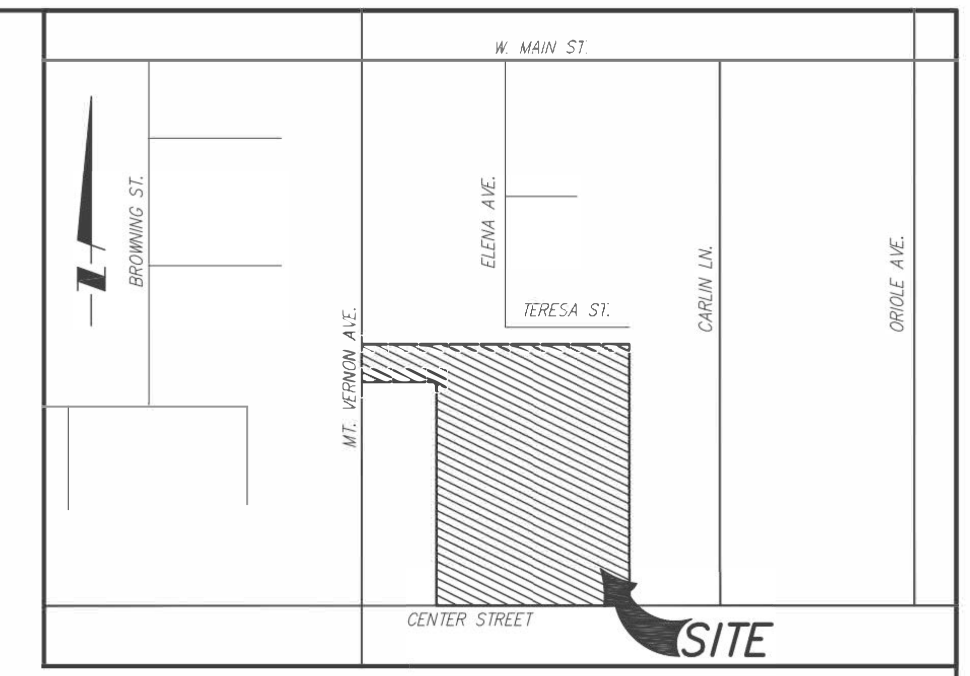


CIVIL ENGINEER
WOODARD GROUP
ANDREW WOODARD
7223 MAGNOLIA AVENUE
RIVERSIDE, CA 92504
PHONE: (951) 907-5077

OWNER/APPLICANT
STEVEN WALKER COMMUNITIES
7111 INDIANA AVE. STE. 300
RIVERSIDE, CA 92504

SOILS ENGINEER & GEOLOGIST
SOILS SOUTHWEST, INC.
897 VIA LATA, SUITE N
COLTON, CA 92324
PH: (909) 370-0474
FAX: (951) 688-5200

ARCHITECT
KTGY ARCHITECTURE + PLANNING
17911 VON KARMEN AVENUE,SUITE 200
IRVINE, CA 92614
PH: (949) 221-6209



VICINITY MAP
SECTION 9, TOWNSHIP 2 SOUTH, RANGE 4 WEST
NOT TO SCALE

LEGAL DESCRIPTION
THE SOUTHWEST QUARTER OF THE NORTHWEST QUARTER OF THE NORTHWEST QUARTER OF SECTION 9; TOWNSHIP 2 SOUTH, RANGE 4 WEST, SBM, RECORDS OF RIVERSIDE COUNTY.

ASSESSOR PARCEL NO

BOOK	PAGE	PARCELS
255	150	001

LEGEND
- EXISTING PROPERTY LINE
- PROPOSED RIGHT OF WAY
- EXISTING RIGHT OF WAY
- EXISTING CENTERLINE
- PROPOSED CURB
- EXISTING CURB
- PROPOSED SIDEWALK
- EXISTING SIDEWALK
- EXISTING DIRT ROAD
- PROPOSED PARKING STRIPE
- EXISTING EASEMENT
- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- EXISTING FENCE
- EXISTING BUILDING
- EXISTING CONCRETE
- PROPOSED UNDERGROUND UTILITY (12" SD)
- EXISTING UNDERGROUND UTILITY (12" SD)
- EXISTING EDGE OF PAVEMENT
- PROPOSED EDGE OF PAVEMENT
- EXISTING CONTOUR ELEVATION (915)
- EXISTING SPOT ELEVATION (x901.5)

CONSTRUCTION NOTES
1. PROPOSED DRIVEWAY APPROACH PER COUNTY OF RIVERSIDE STD. NO. 207A
2. PROPOSED CURB AND GUTTER PER COUNTY OF RIVERSIDE STD. NO. 200.
3. PROPOSED AC PAVING, PROPOSED PRIVATELY MAINTAINED ROAD.
4. PROPOSED CONCRETE HARDSCAPE
5. PROPOSED 6" CURB ONLY
6. PROPOSED 6" CURB AND GUTTER.
7. PROPOSED 3' WIDE CONCRETE RIBBON GUTTER
8. PROPOSED ROLLED CURB WITH GUTTER.
9. PROPOSED ROLLED CURB.
10. PROPOSED COMBINATION RETAINING/FREE STANDING WALL.
11. PROPOSED LANDSCAPE
12. PROPOSED SEWER LINE.
13. PROPOSED WATER LINE.
14. PROPOSED BIORETENTION AREA.
15. PROPOSED TRENCH DRAIN.
16. PROPOSED DRAIN INLET.
17. PROPOSED 8" STORM DRAIN.
18. PROPOSED 12" STORM DRAIN.
19. PROPOSED 18" STORM DRAIN.
20. PROPOSED PARKWAY / UNDER SIDEWALK DRAIN.
21. PROPOSED GATE WITH KNOX BOX.
22. PROPOSED ADA RAMPS.

- PROPOSED AC PAVEMENT
- PROPOSED LANDSCAPE
- PROPOSED CONCRETE
- PROPOSED LANDSCAPE INFILTRATION TRENCH

LEGEND
afc	ARTIFICIAL FILL - COMPACTED
afu	ARTIFICIAL FILL - UNDOCUMENTED
Qof	OLDER ALLUVIAL FAN DEPOSITS (BRACKETED WHERE BURIED)
?- · -	GEOLOGIC CONTACT DOTTED WHERE BURIED, QUERIED WHERE UNKNOWN
5	ESTIMATED REMOVAL DEPTH IN FEET
B-6	APPROXIMATE LOCATION OF BORING (SSI, 2005)

GEOLOGIC MAP AND EXPLORATION LOCATION PLAN
PLATE 1

AGS ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Suite B
Escondido, California 92029
Telephone: (714) 786-5661 Fax: (714) 409-3287

Project#	Report#	Date:
P/W 2101-06	2101-06-B-2	January 2021

GRAPHIC SCALE
40' 20' 0 40' 80'
SCALE: 1" = 40'

MARK	REVISIONS	DATE	BY

CONCEPTUAL GRADING PLAN
TENTATIVE TRACT MAP 37743

FOR: STEVEN WALKER COMMUNITIES

SCALE:	1"=40'
DATE:	11/2020
DESIGNED:	AW
CHECKED:	AW
PLN CK REF:	
F.B.	

woodard group

W.O.	1043
SHEET	1
OF	2 SHEETS
DWG. NO.	1043.001

ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Suite B
Escondido, California 92029
Telephone: (619) 867-0487 Fax: (714) 409-3287

UPDATED GEOTECHNICAL INVESTIGATION AND REVIEW OF ROUGH GRADING PLANS TRACT 32989 HIGHGROVE AREA, COUNTY OF RIVERSIDE, CALIFORNIA

Prepared for:
Highgrove Property Owner, LLC
c/o Foremost Management, LLC
4590 MacArthur Boulevard, Suite 600
Newport Beach, California 92660

Prepared by:
Advanced Geotechnical Solutions, Inc.
485 Corporate Drive, Suite B
Escondido, California 92029

January 6, 2017
Report No. 1612-03-B-1
P/W 1612-03

ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Suite B
Escondido, California 92029
Telephone: (619) 867-0487 Fax: (714) 409-3287

Highgrove Property Owner, LLC
c/o Foremost Management, LLC
4590 MacArthur Boulevard, Suite 600
Newport Beach, California 92660

January 6, 2017
P/W 1612-03
Report No. 1612-03-B-1

Attention: **Mr. Brian Woods**

Subject: ***Updated Geotechnical Investigation and Review of Rough Grading Plans, Tract 32989, Highgrove Area, County of Riverside, California***

References: See Appendix

Gentlemen:

Pursuant to your request, Advanced Geotechnical Solutions, Inc. (AGS) presents herein its geotechnical review of the 1-inch equals 30-foot scale Rough Grading Plan prepared by Adkan Engineers for Tract 32989, northeast of Center Street and Mount Vernon Avenue in the Highgrove Area, County of Riverside, California. This review has utilized geotechnical and geologic data and the geotechnical information presented in the referenced reports and supplemented with additional data from our recent study.

Advanced Geotechnical Solutions, Inc., appreciates the opportunity to provide you with geotechnical consulting services and professional opinions. If you have any questions, please contact the undersigned at (619) 867-0487.

Respectfully Submitted,
Advanced Geotechnical Solutions, Inc.

JOHN J. DONOVAN
RCE 65051, RGE 2790, Reg. Exp. 6-30-17

REGISTERED PROFESSIONAL ENGINEER
JOHN J. DONOVAN
GE 2790
GEOTECHNICAL
STATE OF CALIFORNIA

FRANK J. ECHENIQUE
PG 5531, CEG 2134, Reg. Exp. 7-31-18

CERTIFIED ENGINEERING GEOLOGIST
FRANK J. ECHENIQUE
No. CEG 2134
STATE OF CALIFORNIA

Distribution: (1) Addressee (electronic copy)

1612-03-B-1 (Jan 6, 2017, RGP Review Tract 32989).docx

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UPDATED GEOTECHNICAL INVESTIGATION AND REVIEW OF ROUGH GRADING PLANS TRACT 32989 HIGHGROVE AREA, COUNTY OF RIVERSIDE, CALIFORNIA

1.0 INTRODUCTION

This report presents the results of Advanced Geotechnical Solution's (AGS's) updated geotechnical investigation and review of the 30-scale Rough Grading Plan for Tract Map No. 32989 in the Highgrove Area, County of Riverside, California. The plan was prepared by Adkan Engineers (Adkan) and was provided to AGS on December 28, 2016.

The purpose of our review and report is to present geologic and geotechnical information obtained during the previous geotechnical study by Soils Southwest, Inc. (SSI), and the current study relative to the 30-scale Rough Grading Plan. This study is aimed at providing geologic and geotechnical information and recommendations for the development of Tract 32989 relative to: 1) existing site soil and geology; 2) engineering characteristics of the onsite earth materials; 3) remedial grading; 4) earthwork recommendations; 5) seismic design parameters; and 6) preliminary foundation and retaining wall design parameters.

1.1. Scope of Work

The scope of our current study consists of the following:

- Reviewing the referenced reports;
- Conducting site reconnaissance.
- Analyzing previously generated subsurface and laboratory data relative to the 30-scale Rough Grading Plan and developing site grading recommendations;
- Evaluating the allowable soil bearing pressures and material properties of onsite materials and providing recommendations relative to the design of foundations, retaining walls, and concrete slabs;
- Conducting a seismicity study;
- Preparing and publishing this report which presents geotechnical recommendations pertinent to the accompanying 30-scale Rough Grading Plan for Tract Map No. 32989.

1.2. Geotechnical Study Limitations

The conclusions and recommendations in this report are professional opinions based on the data developed during the investigation by SSI. The conclusions presented herein are based upon the current design as reflected on the Rough Grading Plan. Changes to the plan would necessitate further review.

The materials immediately adjacent to or beneath those observed and sampled may have different characteristics than those observed and sampled. No representations are made as to the quality or extent of materials not observed nor subjected to laboratory testing. Any evaluation regarding the presence or absence of hazardous material is beyond the scope of this firm's services.

2.0 SITE LOCATION AND DESCRIPTION

2.1. Site Location

The site is located northeast of the intersection of Center Street and Mount Vernon Avenue in the Highgrove area of Riverside County (Figure 1). Existing residences bound the site on the north and east. Center Street bounds the site on the south, and Mount Vernon Avenue bounds the site on the west. The site is relatively flat-lying, with a gentle slope to the west-southwest. Blue Mountain is located northeast of the site.

2.2. Site Description

The site is presently vacant and covered with grasses. Overall the site encompasses approximately 860 feet by 840 feet and drains to the west north-west. Elevations on site range from a high of 1126 msl on the southeasterly boundary, to 1095 msl at the northwest corner of the site, for a difference of 31 feet of relief.

2.3. Site History

Historically, the site has been used for agricultural purposes. Minor grading associated with the historic agricultural use has likely occurred on the site, and end-dumped spoil piles associated with construction of the adjacent residential development were observed to occupy the eastern portion of the site on the historic aerial photographs. A summary of site conditions observed on historical photographs/imagery is provided below.

- 1938 – The site, and site vicinity are covered with orchards. No structures or improvements observed.
- 1948 – No changes observed.
- 1966 – Residential development appears along northern site boundary. Site and remainder of site vicinity remains as orchards.
- 1994 – The orchard has been removed from the site. A row of Palm trees appear along the southern site boundary. Residences appear along Mount Vernon Avenue, across the street from the site.
- 2005 – Grading activities appear to be constructing building pads for single family residences along the eastern site boundary. Grading appears to extend into the eastern half of the site. Orchard has been removed from southern site boundary, across Center Street.
- 10/2007 – End-dump piles are seen throughout most of the eastern portion of the site.
- 2009 – Housing tract has been completed along the eastern site boundary.
- 2009 through 2014 - Minor changes observed since prior photograph.

- 1/2014 – end-dump piles are seen very clearly in the same location.
- 1/2015 – The end-dump pile look to have been spread-out.

3.0 PROPOSED DEVELOPMENT

It is proposed to develop a total of 27 residential lots and a WQMP Infiltration Basin at the site. Access to the site is provided via Center Street. Designed cuts and fill depths of up to approximate 5.5 and 6 feet, respectively, are proposed. Combined with the recommended remedial grading, maximum depths of fill may approach 13 feet in the area of Lots 5 through 7. Owing to the gentle topography and proposed remedial grading, the maximum fill differential across each lot is expected to be generally less than 5 feet. Cut slopes of up to approximately 7 feet, and fill slopes up to approximately 7 feet in height are proposed. Fill over cut slopes are planned, with the maximum combined height of up to 14 feet at the southeastern site boundary. All slopes are designed at 2:1 (H:V) inclinations or flatter.

4.0 FIELD AND LABORATORY INVESTIGATION

4.1. Previous Onsite Field Investigation

A preliminary geotechnical investigation for the site was conducted in 2005 by SSI, with their results presenting in the referenced report (SSI 2005). The report was prepared for Victoria Homes, Inc. and assumed that the development would consist of 30 single-family dwellings. Their investigation included advancing four soil borings onsite to depths of up to 31 feet below the surface, as well as performing limited laboratory testing of collected soil samples. Boring logs and laboratory test results from that investigation are included in Appendix B.

In 2010, GSS Engineering performed infiltration testing at the site. Three test pits were excavated in the vicinity of the proposed basin. Infiltration testing was conducted at depths of 3, 5, and 7 feet using a double ring infiltrometer. Infiltration rates of between 1.1 to 1.8 inches per hour were reported.

In 2013, Soil Exploration Company, Inc., performed a infiltration study for the subject site and a nearby site (Tract 28957). Two 2-foot deep test 8-inch diameter holes were excavated at two locations and percolation testing was conducted in each hole. Infiltration rates of around 3.4 to 3.6 inches/hour were reported.

4.2. Current Investigation

AGS has reviewed the previous site investigation reports (SSI 2005; GSS Engineering 2010, and Soil Exploration Company 2013) and conducted site reconnaissance and field mapping at the site as part of this work, as well as reviewing available geotechnical and geologic information for the site vicinity.

5.0 ENGINEERING GEOLOGY

5.1. Geologic Analysis

5.1.1. Literature Review

AGS has reviewed the referenced geologic documents in preparing this study. Where deemed appropriate, this information has been included with this document.

5.1.2. Aerial Photograph Review

AGS has reviewed current and historical the aerial photographs and satellite imagery available through sources on the internet.

5.1.3. Field Mapping

The site geology was mapped during our limited subsurface exploration.

5.2. Geologic and Geomorphic Setting

The site is located within the Perris Block of the Peninsular Ranges geomorphic province bounded by the Santa Ana Mountains at the southwest and the San Bernardino Mountains at the northeast.

5.3. Stratigraphy

The site is underlain by Old Alluvial Fan Deposits (Qof) derived from the nearby granitic mountains. A mid-to-late Pleistocene age has been given to this unit (Morton and Miller 2003- See Figure 2). In some areas of the site, undocumented artificial fill (afu) overlies the old alluvial fan deposits. Detailed descriptions of these units are presented below and the estimated lateral distribution presented on the enclosed Geotechnical Map (Plate 1). The previous geotechnical consultant logged the onsite test pits and borings utilizing a "soil" description. Based upon the regional mapping (Morton and Miller 2003), it is AGS's opinion that the onsite deposits are considered to be Old Alluvial Fan Deposits. Accordingly, our Geotechnical Map depicts our geologic interpretation.

5.3.1. Undocumented Artificial Fill (afu)

Undocumented artificial fill was observed to be placed as end-dumped piles within most of the eastern half of the site. The end-dump piles first appear in the historic aerial imagery from October 2007. The piles look to have been spread-out in the January 2015 aerial imagery. Minor amounts of man-made debris may exist within this fill. The approximate limits of this fill have been included on the Geotechnical Map. The thickness of the fill may be on the order of a few feet thick.

5.3.2. Old Alluvial Fan Deposits (Qof)

Locally derived from the granitic hills to the east of the site, the old alluvial fan deposits surface dips shallowly to the west, which is typical of fan deposits. These consolidated deposits are moderately dissected. The unit was encountered within the borings advanced at the site by SSI who reported this unit to be predominantly brown to light brown, to yellow brown fine to medium grained sand with silt and some pebbles and rock fragments. The moisture content was reported to dry. These deposits were also noted to be slightly porous. The in-situ dry density for samples collected within the upper five feet at the site were reported to be less dense than the samples collected below five feet.

Locally derived from topographic highs east of the site during Pleistocene time, the old alluvial fan deposits are consolidated and moderately dissected. From experience in the site vicinity, the upper four to five feet of the old alluvial fan deposits tend to be weathered and porous.

5.4. Geologic Structure and Tectonic Setting

5.4.1. Tectonic Setting

The site is located within the within the Perris Block geomorphic province, a relatively stable zone of the Peninsular Ranges Structural Province (Woodford et al 1971). Two major active faults make up the boundaries of this region. The northeastern boundary by the San Jacinto Fault, and the southwestern boundary by the Elsinore Fault.

5.4.2. Regional Faulting

The closest regional faults that are capable of affecting the site in the form of seismic shaking are the San Andreas Fault and the San Jacinto Fault (See Fault Map, Figure 3). These fault systems have been studied extensively and in a large part control the geologic structure of southern California.

5.4.2.1. *San Jacinto Fault System*

The San Jacinto fault zone is the closest known active fault to the site and consists of a series of closely spaced faults that form the western margin of the San Jacinto Mountains. The fault zone extends from its junction with the San Andreas fault in San Bernardino, southeasterly toward the Brawley area, where is continues south of the international border as the Imperial transform fault. The San Jacinto fault zone has a high level of historical seismic activity, with at least ten damaging (Mw 6-7) earthquakes having occurred between 1890 and 1986. Offset on the fault is predominantly right-lateral similar to the San Andreas. Maximum credible earthquake magnitude of 6.7 is expected on the San Bernardino segment. The closest distance to a mapped splay of the San Jacinto fault (San Bernardino segment) from the site is approximately 2 miles to the northeast.

5.4.2.2. *San Andreas Fault System*

The active San Andreas Fault zone is located approximately 10 miles northeast of the project. This fault zone is California's most prominent structural feature, trending in a general northwest direction almost the entire length of the state. The southern segment of the fault is approximately 280 miles long and extends from the Transverse Ranges west of Tejon Pass on the north to the Mexican border and beyond on the south. The last major earthquake along the San Andreas fault zone in Southern California was the 1857 Magnitude 8.3 Fort Tejon earthquake.

5.4.3. Geologic Structure

The site is underlain by old alluvial fan deposits. Bedding was not observed within this unit, and it is assumed that it exists as a flat-lying unit with a slight dip to the west. No faults have been mapped within the site, or immediate site vicinity.

5.5. Groundwater

Groundwater was not encountered during our subsurface investigation nor during SSI's investigation. Groundwater is several hundred feet below the existing grade and is not expected to impact the site development.

5.6. Non-seismic Geologic Hazards

5.6.1. Mass Wasting

Due to the developed nature of the surrounding site area and the flat lying topography, mass wasting and debris flows are not considered a geologic hazard to the site.

5.6.2. Flooding

According to FEMA, the site is not located within a FEMA flood zone (effective 8/28/2008).

5.6.3. Subsidence and Ground Fissuring

Due to the dense nature of the old alluvial fan deposits underlying the site, as well as the anticipated removal of the weathered old alluvial fan deposits and undocumented fill below the development, the potential for subsidence and ground fissuring due to settlement of the underlying earth materials is unlikely.

5.7. Seismic Hazards

The site is located in the tectonically active Southern California area, and will therefore likely experience shaking effects from earthquakes. The type and severity of seismic hazards affecting the site are to a large degree dependent upon the distance to the causative fault, the intensity of the seismic event, the direction of propagation of the seismic wave and the underlying soil characteristics. The seismic hazard may be primary, such as surface rupture and/or ground shaking, or secondary, such as liquefaction, seismically induced slope failure or dynamic settlement. The following is a site-specific discussion of ground motion parameters, earthquake-induced landslide hazards, settlement, and liquefaction. The purpose of this analysis is to identify potential seismic hazards and propose mitigations, if necessary, to reduce the hazard to an acceptable level of risk. The following seismic hazards discussion is guided by the California Building Code (2010), CDMG (2008), and Martin and Lew (1998).

5.7.1. Surface Fault Rupture

Surface rupture is a break in the ground surface during or as a consequence of seismic activity. To a large part, research supports the conclusion that active faults tend to rupture at or near pre-existing fault planes. The site is not located in a State of California Alquist-Priolo Fault Zone and faulting has not been mapped at the site. It is AGS's opinion that the likelihood of significant fault rupture on the site is low.

5.7.2. Historical Earthquakes

Earthquakes that have historically impacted the area include the 1857 Fort Tejon Earthquake, the 1858 San Bernardino Earthquake, the 1899 Cajon Pass earthquake, the 6.8 magnitude 1918 San Jacinto earthquake near Hemet, the 6.3 magnitude 1923 North San Jacinto earthquake near Highgrove, the 1981 Sylmar Earthquake, the 5.9 magnitude 1987 Whittier Narrows Earthquake, the 6.4 magnitude Big Bear earthquake, 6.7 magnitude 1994 Northridge Earthquake, and 5.4 magnitude 1990 Upland earthquake.

FIGURE 5.7.2, MAP OF HISTORIC EARTHQUAKES (1910-PRESENT)

5.7.3. Seismic Design Parameters

The following seismic design parameters are presented to be code compliant to the California Building Code (2013). Upon completion of grading, the lots will be underlain with varying depths of fill over very old alluvial soils. The Site Class of D has been designated.

Using the computer program Seismic Hazard Curves, Response Parameters and Design Parameters, provided by the United States Geological Survey, and 2010 ASCE 7 criterion, the seismic design category for 0.20 second (Ss) and 1.0 second (S1) period response accelerations have been determined (2013 CBC, Section 1613.5.1) along with the design spectral response accelerations (2013 CBC, Sections 1613.5.3 and 1613.5.4). A Seismic Design Category of E was determined based on 1613.5.6 of the 2013 CBC, assuming buildings are in Risk Categories I, II, or III. The mapped acceleration parameters are provided for Site Class “B”. Adjustments for other Site Classes are made, as needed, by utilizing Site Coefficients F_a and F_v for determination of MCE_R spectral response acceleration parameters S_{MS} for short periods and S_{M1} for 1.0 second period (CBC, 2013 1613.3.3). Five-percent damped design spectral response acceleration parameters S_{DS} for short periods and S_{D1} for 1.0 second period can be determined from the equations in CBC 2013, Section 1613.3.4. A site location of Latitude 34.0166°N and Longitude 117.3124°W was utilized. Results are presented in Table 5.7.3, below. Using the United States Geological Survey (USGS) web-based ground motion calculator, the site class modified PGA_M (F_{PGA}*PGA) was determined to be 0.712g. This value does not include near-source factors that may be applicable to the design of structures on site.

TABLE 5.7.3
Seismic Design Parameters

Site Class	Seismic Design Category	Mapped Spectral Response Values		Design Spectral Response Accelerations		Spectral Response Accelerations	
		S_s (g) at 0.2 s	S_1 (g) at 1.0 s	S_{DS} (g) at 0.2 s	S_{D1} (g) at 1.0 s	S_{MS} (g) at 0.2 s	S_{M1} (g) at 1.0 s
D (Stiff Soil)	E	1.822	0.803	1.215	0.803	1.822	1.205

5.7.4. Liquefaction/Dynamic Settlement

Liquefaction is the phenomenon in which the buildup of excess pore pressures, in saturated granular soils due to seismic agitation, results in a temporary “quick” or “liquefied” condition. The site has mapped by the County of Riverside as being in an area with a low susceptibility to liquefaction. Due to the lack of shallow groundwater and the relatively dense nature of the underlying old alluvial fan deposits, the potential for liquefaction is low. Upon completion of remedial grading, seismically induced dynamic settlement in non-saturated deposits (dry sand settlement) is not expected to adversely impact the site.

5.7.5. Lateral Spreading

Liquefaction-induced lateral spreading is defined as the finite, lateral displacement of gently sloping ground as a result of pore pressure build-up or liquefaction in a shallow underlying deposit during an earthquake. Due to the lack of shallow ground water, the potential for lateral spreading is very low.

5.7.6. Seismically Induced Landsliding

The site is very gently sloping to level, and nearby significant slopes are not present. As such, the possibility for seismically induced landsliding to impact the development is considered nil.

5.7.7. Earthquake Induced Flooding

Earthquake induced flooding can be caused by tsunamis, dam failures, or seiches. Also, earthquakes can cause landslides that dam rivers and streams, causing flooding upstream above the dam and also downstream when these dams are breached. A seiche is a free or standing-wave oscillation on the surface of water in an enclosed or semi-enclosed basin. The wave can be initiated by an earthquake and can vary in height from several centimeters to a few meters. Due to the lack of a freestanding body of water nearby, the potential for a seiche impacting the site is considered to be non-existent.

Considering the lack of any dams or permanent water sources upstream, earthquake induced flooding caused by a dam failure is considered to be non-existent.

Considering the distance of the site from the coastline, the potential for flooding due to tsunamis is extremely low.

6.0 GEOTECHNICAL ENGINEERING

Presented herein is a general discussion of the geotechnical properties of the various soil types and the analytic methods used in this report.

6.1. Material Properties

6.1.1. Excavation Characteristics

Based on our previous experience with similar projects near the subject site and the information gathered during our investigation for this report, it is our opinion that the majority of the earth material onsite can be readily excavated with conventional grading equipment.

6.1.2. Compressibility

The onsite materials that are compressible include; topsoil, undocumented artificial fill, and weathered old alluvial fan deposits. These compressible materials will require removal from fill areas prior to placement of fill and where exposed at grade in cut areas.

6.1.3. Collapse Potential/Hydro-Consolidation

The hydro-consolidation process is a singular response to the introduction of water into collapse-prone alluvial soils. Upon initial wetting, the soil structure and apparent strength are altered and a virtually immediate settlement response occurs. The topsoil, artificial fill, and weathered old alluvial fan deposits are subject to hydro-consolidation and therefore will need to be removed before placement of compacted fill. Two consolidation tests conducted by SSI indicated a high potential for hydro-collapse (~ 5 percent) for a 5-foot sample (B-2 at 5 feet) and a slight to moderate potential (~1 percent) for a sample at 8 feet (B-1 at 8 feet). The un-weathered underlying old alluvial fan deposits are considered as having a slight potential for hydro-consolidation.

6.1.4. Expansion Potential

The expansion potential of the onsite materials is expected to be "very low" to "low" when classified in accordance with ASTM D 4829. It is our anticipation that the majority of the fills derived primarily from onsite materials will produce a "very low" to "low" expansion potential. Further testing should be conducted during and upon completion of the grading operations to confirm the specific as-graded conditions on a lot-by-lot basis or to modify the design recommendations accordingly.

6.1.5. Shear Strength

Shear strength testing was conducted by SSI on one remolded sample of the alluvial materials. The results are presented in Appendix B. The shear strengths that were used by AGS for design are presented in Table 6.1.5.

TABLE 6.1.5
Shear Strengths Used for Design (Ultimate)

Material	Cohesion (psf)	Friction Angle (degrees)	Moist Density (pcf)
Compacted Fill and Older Alluvial Materials	275	33	130

6.1.6. Chemical and Resistivity Test Results

Soluble sulfate testing and resistivity testing were not performed by AGS. Based upon the fine to medium grained silty sands and clayey sands found onsite, we anticipate that some of the onsite soils may be corrosive to ferrous metals. Upon completion of grading, samples should be collected and tested. Final recommendations should be based on the results of those tests.

6.1.7. Earthwork Adjustments

The following average earthwork adjustment factors are presented for use in evaluating earthwork quantities. These numbers are considered approximate and should be refined during grading when actual conditions are better defined. Contingencies should be made to adjust the earthwork balance during grading if these numbers are adjusted.

TABLE 6.1.7
EARTHWORK ADJUSTMENTS

Geologic Unit	Approximate Range
Topsoil and Undocumented Fill	15 to 25 percent shrinkage
Old Alluvial Fan Deposits	5 to 15 percent shrinkage

6.1.8. Pavement Support Characteristics

Compacted fill derived from onsite soils is expected to possess "moderate" to "good" pavement support characteristics. Testing should be completed once subgrade elevations are reached for the onsite roadways. For initial design we used a Resistance Value of 30.

6.2. Analytical Methods

6.2.1. Slope Stability Analysis

Stability analyses were performed for both static and seismic (pseudo-static) conditions using the GSTABL7 computer program. The Modified Bishop method was used to analyze circular type failures. The critical failure surface determined in the static analysis was used in the pseudo-static analysis. A horizontal destabilizing seismic coefficient (kh) of 0.20g was selected for the site and used in the pseudo-static analyses.

Surficial stability analyses were conducted using an infinite height slope method assuming seepage parallel to the slope surface.

6.2.2. Pavement Design

Asphalt concrete pavement sections have been designed using the recommendations and methods presented in the Caltrans Highway Design Manual.

6.2.3. Bearing Capacity and Lateral Pressure

Ultimate bearing capacity values were obtained using the graphs and formula presented in NAVFAC DM-7.1. Allowable bearing was determined by applying a factor of safety of at least 3 to the ultimate bearing capacity. Static lateral earth pressures were calculated using Rankine methods for active and passive cases.

7.0 EARTHWORK CONCLUSIONS AND RECOMMENDATIONS

Based on the information presented herein and our experience in the vicinity of the subject site, it is AGS's opinion that the proposed development of Tract 32989 is feasible, from the geotechnical point of view, provided that the constraints discussed in this report are addressed in the design and construction of each proposed residential structure. All grading shall be accomplished under the observation and testing of the project Geotechnical Consultant in accordance with the recommendations contained herein, the current codes practiced by the County of Riverside and this firm's Earthwork Specifications (Appendix D).

7.1. Site Preparation and Removals/Overexcavation

Topsoil, artificial fill, and weathered old alluvial fan deposits and highly weathered bedrock should be removed from fill areas prior to placement of fill and should be removed from shallow cut areas where exposed at finish grades. Guidelines to determine the depth of removals are presented below; however, the exact extent of the removals must be determined in the field during grading, when observation and evaluation of the greater detail afforded by those exposures can be performed by the Geotechnical Consultant. In general, removed soils will be suitable for reuse as compacted fill when free of deleterious materials and after moisture conditioning.

7.1.1. Site Preparation

Existing vegetation, trash, debris, and other deleterious materials should be removed and wasted from the site prior to commencing removal of unsuitable soils and placement of compacted fill materials. Additionally, all pre-existing foundations elements, standpipes, irrigation lines, and utility conduits should be removed and wasted off-site. Concrete can be placed in the fill provided it is broken down into pieces smaller than 12 inches (largest dimension). Cesspools and septic systems should be properly removed and/or backfilled in accordance with the local governing agency.

7.1.2. Topsoil (unmapped)

Loose, compressible topsoil should be removed to expose the underlying competent old alluvial fan deposits prior to placement of compacted fill and when exposed in shallow cut areas. An average removal depth of 1 to 2 feet is anticipated for removal of topsoil. In general, onsite soils are suitable to be re-used as structural fill when properly moisture conditioned.

7.1.3. Undocumented Artificial Fill (afu)

Undocumented artificial fill should be removed prior to fill placement. Removals should extend below the undocumented fill until competent old alluvial fan deposits are encountered.

7.1.4. Old Alluvial Fan Deposits (Qof)

The Old Alluvial Fan Deposits were generally observed to be medium dense to dense and suitable for support of fill. The weathered portion (4 to 7 feet) of the old alluvial fan deposits will require removal to expose competent material.

7.1.5. Overexcavation

It is recommended that the cut lots and transition lots created after removal activities be overexcavated to provide a minimum of four (4) feet of compacted engineered fill below pad grades, or two (2) feet below foundations, whichever is deeper.

Streets should be overexcavated to provide a minimum of 2 feet of compacted fill below the subgrade.

7.1.6. Removals Along Grading Limits and Property Lines

Removals of unsuitable soils will be required prior to fill placement along the grading limit. A 1:1 projection, from toe of slope or grading limit, outward to competent materials should be established, when possible. Where removals are not possible due to grading limits, property line or easement restrictions, removals should be initiated at the grading boundary (property line, easement, grading limit or outside the improvement) at a

1:1 ratio inward to competent materials. This reduced removal criteria should not be implemented prior to review by the Geotechnical Consultant and approval by the Owner. Where this reduced removal criteria is implemented, special maintenance zones may be necessary. These areas, if present, will need to be identified during grading. Alternatively, grading limits can be initiated offsite.

7.2. Slope Stability and Remediation

Proposed cut slope heights to be created during this phase of grading are on the order of 7 feet or less, and proposed fill slopes are on the order of 7 feet or less. Fill over cut slopes are also proposed. Upon the conclusion of unsuitable soils removals, most of the cut slope and fill over cut slopes will be rendered fill slopes. The highest fill over cut slope is located along the easterly boundary of the site. Upon conclusion of remedial grading, the cut slope portion of the fill over cut slope will be converted to a fill slope, producing a fill slopes up to roughly 14 feet in height (above Lot 13). AGS evaluated the global stability of the higher combined fill over cut slope using GSTABL7 (Cross-Section A-A'). The results of the analysis, included in Appendix C, indicate that the proposed slope is grossly stable in static and seismic conditions.

7.2.1. Cut Slopes

Cut slopes have been designed at a slope ratio of 2:1 (horizontal to vertical). If loose, uncemented, or poorly consolidated old alluvial soils are exposed on the cut slopes, the slope may need to be replaced with a stabilization fill slope. Where slopes are to be stabilized, a keyway should be constructed in competent materials. Backdrain systems are not expected to be necessary, due to the shallow slope heights. Proposed keyway locations are shown on the Geotechnical Map.

All cut slopes should be observed by the engineering geologist during grading. Modifications to the recommendations presented herein will be necessary and should be based upon conditions exposed in the field at the time of grading.

7.2.2. Fill Slopes

Fill slopes are designed at 2:1 ratios (H:V). Fill slopes, when properly constructed with onsite materials, are expected to be grossly stable as designed. Fill slopes will be subject to surficial erosion and should be landscaped as quickly as possible.

Keys should be constructed at the toe of all fill slopes "toeing" on existing or cut grade, including fill slopes toeing on existing fill. Fill keys should have a minimum width equal to one-half the height of ascending slope, or an equipment width, whichever is greater. Unsuitable soil removals below the toe of proposed fill slopes should extend from the catch point of the design toe outward at a minimum 1:1 projection into approved material to establish the location of the key.

7.2.1. Fill over Cut Slopes

Several fill over cut slopes are proposed. After remedial grading, it is expected that these slopes will be rendered as fill slopes. Any remaining cut portions should be removed and a keyway established at the low lot overexcavation elevation. Keys should have a minimum width equal to one-half the height of ascending slope, or an equipment width, whichever is greater.

7.2.2. Surficial Stability

The surficial stability of 2:1 fill and cut slopes have been analyzed, and the analysis presented in Appendix C indicates a factor-of-safety in excess of code minimums. When fill and cut slopes are properly constructed and maintained, satisfactory performance can be anticipated although slopes will be subject to erosion, particularly before landscaping is fully established.

7.2.3. Skin Cut and Skin Fill Slopes

Some skin fills are proposed along the easterly site boundary but are expected to be replaced with fill slopes or stabilization fills during remedial grading. Skin cut or thin skin fill sections may be created during grading. For all such conditions, it is recommended that a backcut and keyway be established such that a minimum fill thickness equal to one-half the remaining slope height, and not less than an equipment width is provided, as shown on Grading Details 5 and 6.

Where the design cut is insufficient to remove all unsuitable materials, overexcavation and replacement with a stabilization fill will be required, as shown on Grading Detail 6 in Appendix D.

7.2.4. Natural Slopes

Significant descending natural slopes are absent from the project.

A shallow ascending "natural" slope is located along the easterly boundary. This slope was constructed when the adjacent site was graded circa 2005. It is unknown if a keyway was constructed at the toe of this slope. However, this slope will be replaced with a stabilization fill slope.

7.2.5. Temporary Backcut Stability

Temporary backcuts should be laid back at gradients no steeper than 1:1 to heights of up to 10 feet, and 1½:1 (horizontal:vertical) for heights greater than 10 feet. Flatter backcuts may be necessary where geologic conditions dictate and where minimum width dimensions are to be maintained.

Care should be taken during remedial grading operations in order to minimize risk of failure. Should failure occur, complete removal of the disturbed material will be required.

In consideration of the inherent instability created by temporary construction of backcuts, it is imperative that grading schedules be coordinated to minimize the unsupported exposure time of these excavations. Once started these excavations and subsequent fill operations should be maintained to completion without intervening delays imposed by avoidable circumstances. In cases where five-day workweeks comprise a normal schedule, grading should be planned to avoid exposing at-grade or near-grade excavations through a non-work weekend. Where improvements may be affected by temporary instability, either on or offsite, further restrictions such as slot cutting, extending work days, implementing weekend schedules, and/or other requirements considered critical to serving specific circumstances may be imposed.

7.2.6. Geologic Observation During Grading

All temporary slope excavations, including front, side and backcuts, and all cut slopes should be mapped to verify the geologic conditions that were modeled prior to grading are consistent with the exposures during the grading. It is likely that slope stability analyses and designed keyways may have to be modified based on conditions exposed during grading.

7.3. Subsurface Drainage

Canyon subdrains are not anticipated for this project due to the relatively flat topography of the site. Heel drains shall be placed at the heel of all fill-over-cut keyways and drains should be installed behind all retaining walls.

7.4. Seepage

Seepage, when encountered during grading, should be evaluated by the Geotechnical Consultant. In general, seepage is not anticipated to adversely affect grading. If seepage is excessive, remedial measures such as horizontal drains or under drains may need to be installed. No groundwater or seepage was encountered during the investigation; therefore, seepage is not expected.

7.5. Earthwork Considerations

7.5.1. Compaction Standards

All fills should be compacted to at least 90 percent of the maximum dry density as determined by ASTM D1557. All loose and or deleterious soils should be removed to expose firm native soils or bedrock. Prior to the placement of fill, the upper 6 to 8 inches should be ripped, moisture conditioned to optimum moisture or slightly above optimum, and compacted to a minimum of 90 percent of the maximum dry density (ASTM D1557). Fill should be placed in thin (6 to 8-inch) lifts, moisture conditioned to optimum moisture or slightly above, and compacted to 90 percent of the maximum dry density (ASTM D1557) until the desired grade is achieved.

7.5.2. Benching

Where the natural slope is steeper than 5-horizontal to 1-vertical and where determined by the Geotechnical Consultant, compacted fill material shall be keyed and benched into competent materials.

7.5.3. Mixing and Moisture Control

In order to prevent layering of different soil types and/or different moisture contents, mixing and moisture control of materials will be necessary. The preparation of the earth materials through mixing and moisture control should be accomplished prior to and as part of the compaction of each fill lift. Water trucks or other water delivery means may be necessary for moisture control. Discing may be required when either excessively dry or wet materials are encountered.

7.5.4. Haul Roads

All haul roads, ramp fills, and tailing areas shall be removed prior to engineered fill placement.

7.5.5. Import Soils

Import soils, if required, should consist of clean, structural quality, compactable materials similar to the on-site soils and should be free of trash, debris or other objectionable materials. Import soils should be tested and approved by the Geotechnical Consultant prior to importing. At least three working days should be allowed in order for the geotechnical consultant to sample and test the potential import material.

7.5.6. Oversize Rock

Oversize rock is not anticipated to be encountered within the old alluvial fan deposits at the site. If encountered, rock over 8-inches should not be placed within 10 feet of finish grade or within 2 feet of the deepest utility in the streets. Oversize rock should be kept minimally 5 feet outside and below proposed culverts, pipes, etc.

7.5.7. Fill Slope Construction

Fill slopes may be constructed by preferably overbuilding and cutting back to the compacted core or by back-rolling and compacting the slope face. The following recommendations should be incorporated into construction of the proposed fill slopes.

Care should be taken to avoid spillage of loose materials down the face of any slopes during grading. Spill fill will require complete removal before compaction, shaping and grid rolling.

Seeding and planting of the slopes should follow as soon as practical to inhibit erosion and deterioration of the slope surfaces. Proper moisture control will enhance the long-term stability of the finish slope surface.

7.5.7.1. *Overbuilding Fill Slopes*

Fill slopes should be overfilled to an extent determined by the contractor, but not less than 2 feet measured perpendicular to the slope face, so that when trimmed back to the compacted core, the compaction of the slope face meets the minimum project requirements for compaction.

Compaction of each lift should extend out to the temporary slope face. The sloped should be back-rolled at fill intervals not exceeding 4 feet in height unless a more extensive overfilling is undertaken.

7.5.7.2. *Compacting the Slope Face*

As an alternative to overbuilding the fill slopes, the slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Back-rolling at more frequent intervals may be required. Compaction of each fill should extend to the face of the slope. Upon completion, the slopes should be watered, shaped, and track-walked with a D-8 bulldozer or similar equipment until the compaction of the slope face meets the minimum project requirements. Multiple passes may be required.

7.5.8. Utility Trench Excavation and Backfill

All utility trenches should be shored or laid back in accordance with applicable OSHA standards.

Mainline and lateral utility trench backfill should be compacted to at least 90 percent of maximum dry density as determined by ASTM D 1557. Onsite soils may be suitable for use as bedding material and will be suitable for use in backfill, provided oversized materials are removed. No surcharge loads should be imposed above excavations. This includes spoil piles, lumber, concrete trucks or other construction materials and equipment. Drainage above excavations should be directed away from the banks. Care should be taken to avoid saturation of the soils.

Compaction should be accomplished by mechanical means. Jetting of native soils will generally not be acceptable.

To reduce moisture penetration beneath the slab-on-grade areas, shallow utility trenches should be backfilled with lean concrete or concrete slurry where they intercept the foundation perimeter. As an alternative, such excavations can be backfilled with native soils, moisture-conditioned to over optimum, and compacted to a minimum of 90 percent relative compaction.

7.5.9. Flatwork and Slab-on-Grade Subgrade Preparation

7.5.9.1. *Slab-on-Grade Subgrade*

The subgrade below the slab-on-grade should be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557.

The subgrade below exterior slabs, sidewalks, driveways, patios, etc. should be moisture conditioned to a minimum of 110 percent of optimum moisture content prior to concrete placement.

7.5.9.2. *Flatwork Subgrade*

The subgrade below exterior slabs, sidewalks, driveways, patios, etc. should be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557.

The subgrade below exterior slabs, sidewalks, driveways, patios, etc. should be moisture conditioned to a minimum of 110 percent of optimum moisture content prior to concrete placement.

8.0 DESIGN RECOMMENDATIONS

From a geotechnical perspective, the proposed development is feasible provided the following recommendations are incorporated into the design and construction. Preliminary design recommendations are presented herein and are based on some of the general soils conditions encountered during the referenced geotechnical investigations. As such, recommendations provided herein are considered preliminary and subject to change based on the results of additional observation and testing that will occur during grading operations. Final design recommendations should be provided in a final rough/precise grading report.

8.1. Structural Design Recommendations

The proposed residential improvements can be supported on either post-tensioned foundations or conventionally reinforced foundations.

8.1.1. Foundation Design

8.1.1.1. *Conventional Foundations*

Foundations may be designed using the values provided in the following table. These values may be increased as allowed by Code to resist transient loads such as wind or seismic. Building code and structural design considerations may govern depth and reinforcement requirements and should be evaluated.

TABLE 8.1.1.1 CONVENTIONAL FOUNDATION DESIGN PARAMETERS	
Allowable Bearing	2,000 psf, based on a minimum width and depth
Lateral Bearing (Level Condition)	350 psf/foot of depth to a maximum of 2,000 psf
Lateral Bearing (Descending 2:1 Slope)	150 psf/foot of depth to a maximum of 1,500 psf
Sliding Coefficient	0.35
Expansion Index	**"Very Low" to "Low"**
Continuous Footings	
Footing Depth*	12 inches (one story), 18 inches (two stories)
Footing Width	12 inches (one story), 15 inches (two stories)
Reinforcement	No. 4 rebar - 2 on top, 2 on bottom or No. 5 rebar, 1 on top and bottom

***Notes on Footing Embedment:** Depth of embedment should be measured below lowest adjacent finish grade.

Footings Adjacent to Swales and Slopes: If exterior footings adjacent to drainage swales are to exist within 5 feet horizontally of the swale, the footing should be embedded sufficiently to assure embedment below the swale bottom is maintained. Footings adjacent to slopes should be embedded such that at least 5 feet is provided horizontally from edge of the footing to the face of the slope.

8.1.1.2. *Post Tensioned Foundations*

Post-tensioned foundations may be designed using the values provided in the following table.

TABLE 8.1.1.2
POST-TENSIONED FOUNDATION DESIGN PARAMETERS

Soil Category	Expansion Index	Tract No.	Lot Nos.	Edge Beam Embedment (inches)*	Edge Lift**		Center Lift**	
					Em (ft.)	Ym (in.)	Em (ft.)	Ym (in.)
I	"Very Low to Low"	***	***	12	5.4	0.54	9.0	-0.23

Moisture Barrier	An approved moisture and vapor barrier should be placed below all slabs-on-grade within living and moisture sensitive areas as discussed in Section 8.1.1.7	
Slab Subgrade Moisture	Soil Category I	Minimum of 110 percent of optimum moisture to a depth of 12 inches prior to placing concrete
Footing Embedment**	Depth of embedment should be measured below lowest adjacent finish grade. **Footings Adjacent to Swales and Slopes:** If exterior footings adjacent to drainage swales are to exist within 5 feet horizontally of the swale, the footing should be embedded sufficiently to assure embedment below the swale bottom is maintained. Footings adjacent to slopes should be embedded such that at least 5 feet is provided horizontally from edge of the footing to the face of the slope.	

NOTES: **The values of predicted lift are based on the procedures outlined in the *Design of Post-Tensioned Slabs-on-Ground*, Third Edition and related addendums. No corrections for vertical barriers at the edge of the slab or other corrections (e.g. horizontal barriers, tree roots, adjacent planters) are assumed. The values assume Post-Equilibrium conditions exist (as defined by the Post Tensioning Institute), and these conditions created during construction should be maintained throughout the life of the structure. Please refer to the appended Homeowner Maintenance Guidelines for a summary of recommended practices to maintain the conditions created during construction.

***Final design parameters should be provided in a final grading report and should be based on as-graded soil conditions. For budgeting purposes, a Soil Category of I may be assumed.

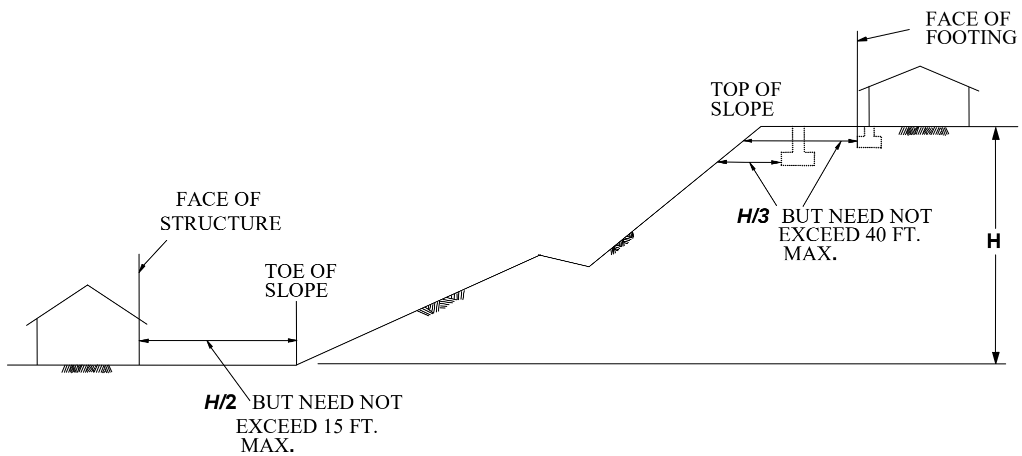
8.1.1.3. *Isolated Footings*

Isolated footings outside the structure footprint should be tied with grade beams to the structure in two orthogonal directions.

8.1.1.4. *Deepened Footings and Setbacks*

Improvements constructed in proximity to natural slopes or properly constructed, manufactured slopes can, over a period of time, be affected by natural processes including gravity forces, weathering of surficial soils and long-term (secondary) settlement. Most building codes, including the California Building Code, require that structures be set back or footings deepened where subject to the influence of these natural processes.

For the subject site, where foundations for residential structures are to exist in proximity to slopes, the footings should be embedded to satisfy the requirements presented in the following figure



8.1.1.5. *Footing Excavations*

Footing excavations should be observed by the geotechnical consultant. Spoils from the footing excavations should not be placed on slab-on-grade areas unless the soils are properly compacted. The footing excavations should not be allowed to dry back and should be kept moist until concrete is poured. The excavations should be free of all loose and sloughed materials, be neatly trimmed, and moisture conditioned at the time of concrete placement.

8.1.1.6. *Garage Entrances*

A grade beam reinforced continuously with the garage footings should be constructed across the garage entrance, tying together the ends of the perimeter footings and between individual spread footings. This grade beam should be embedded at the same depth as the adjacent perimeter footings. A thickened slab, separated by a cold joint from the garage beam, should be provided at the garage entrance. The thickened edge should be a minimum of 6 inches deep.

8.1.1.7. *Moisture and Vapor Barrier*

A moisture and vapor retarding system should be placed below the slabs-on-grade in portions of the structure considered to be moisture sensitive. The retarder should be of suitable composition, thickness, strength and low permeance to effectively prevent the migration of water and reduce the transmission of water vapor to acceptable levels. Historically, a 10-mil plastic membrane, such as *Visqueen*, placed between one to four inches of clean sand, has been used for this purpose. More recently Stego® Wrap or similar underlayments have been used to lower permeance to effectively prevent the migration of water and reduce the transmission of water vapor to acceptable levels. The use of this system or other systems, materials or techniques can be considered, at the discretion of the designer, provided the system reduces the vapor transmission rates to acceptable levels.

8.1.1.8. *Settlement*

Settlements are likely to be produced from structural loads and long-term settlement of the fill (secondary consolidation). After remedial grading, the deepest deposits of fill are expected to be on the order of 13 feet. The maximum fill differential across a lot is expected to be on the order of 5 feet.

For foundations designed based on the above values, total settlements under structural loads should be less than ½ inches. Structures should also be designed to accommodate long-term settlement of the fill. The settlement potential and estimated differential settlement should be further evaluated during grading and provided in a final grading report based on the actual depths and properties of the underlying fill, underlying profile, and structure sitings. For preliminary planning purposes, structures should be designed to accommodate differential settlement on the order of 3/8 inch across 20 feet.

8.1.2. Concrete Design

Preliminary testing for sulfate exposure was not conducted by AGS or others. Final testing should be conducted once the final distribution of soils is known after the mass grading. It should be recognized that some fertilizers have been known to leach water-soluble sulfate compounds into soils containing "negligible" sulfate concentrations and increase the sulfate concentrations to potentially detrimental levels. Accordingly, it is suggested that the homeowners be advised of their responsibility to maintain existing conditions.

8.1.3. Retaining Wall Design

The foundations for retaining walls should be founded on compacted fill and may be designed in accordance with the recommendations provided in Table 8.1.1.1, Conventional Foundation Design Parameters. When calculating the lateral resistance, the upper 12 inches of soil cover should be ignored in areas that are not covered with hardscape. Retaining wall footings should be designed to resist the lateral forces by passive soil resistance and/or base friction as recommended for foundation lateral resistance.

Retaining walls should be designed to resist earth pressures presented in the following table. These values assume that the retaining walls will be backfilled non-expansive free draining materials (Sand Equivalent of 20 or better and an Expansion Index of 20 or less). Most of the materials onsite are considered free-draining and will be suitable for placement behind these walls. If non-free draining materials are utilized, revised values will need to be provided to design the retaining walls. Retaining walls should be designed to resist additional loads such as construction loads, temporary loads, and other surcharges as evaluated by the structural engineer.

TABLE 8.1.3
RETAINING WALL EARTH PRESSURES

"Native" Backfill Materials (γ=130pcf, EI$\leq$20)

	Level Backfill		**2:1 Backfill**	
	Rankine Coefficients	**Equivalent Fluid Pressure (psf / lineal foot)**	**Rankine Coefficients**	**Equivalent Fluid Pressure (psf / lineal foot)**
Active Pressure	$K_a = 0.29$	38	$K_a = 0.38$	50
Passive Pressure	$K_p = 3.39$	440	$K_p = 2.58$	335
At Rest Pressure	$K_o = 0.46$	59	$K_o = 0.66$	86

In addition to the above static pressures, unrestrained retaining walls located should be designed to resist seismic loading as required by the 2013 CBC. The seismic load can be modeled as a thrust load applied at a point 0.6H above the base of the wall, where H is equal to the height of the wall. This seismic load (in pounds per lineal foot of wall) is represented by the following equation:

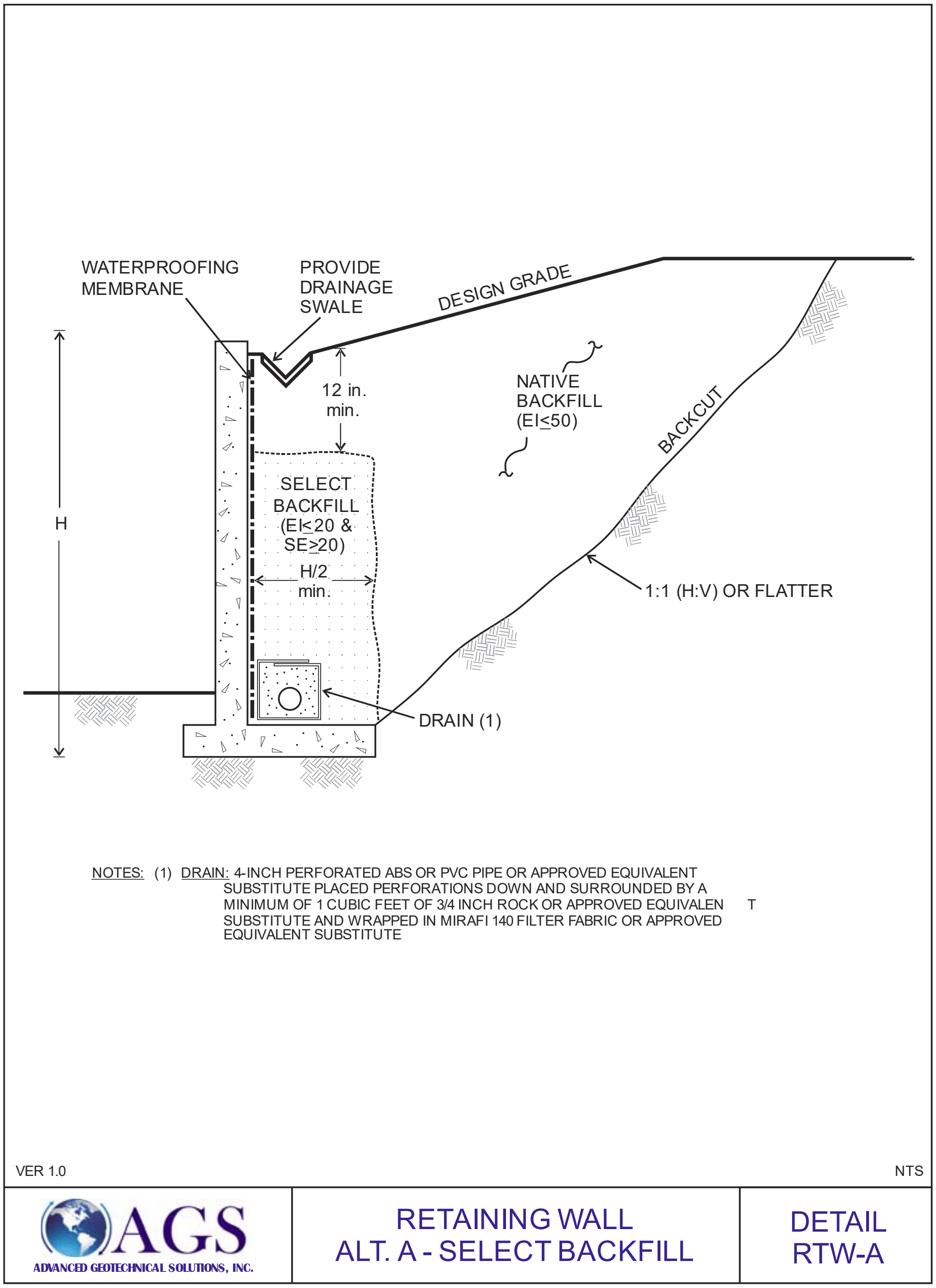
$$Pe = \tfrac{3}{8} * \gamma * H^2 * k_h$$

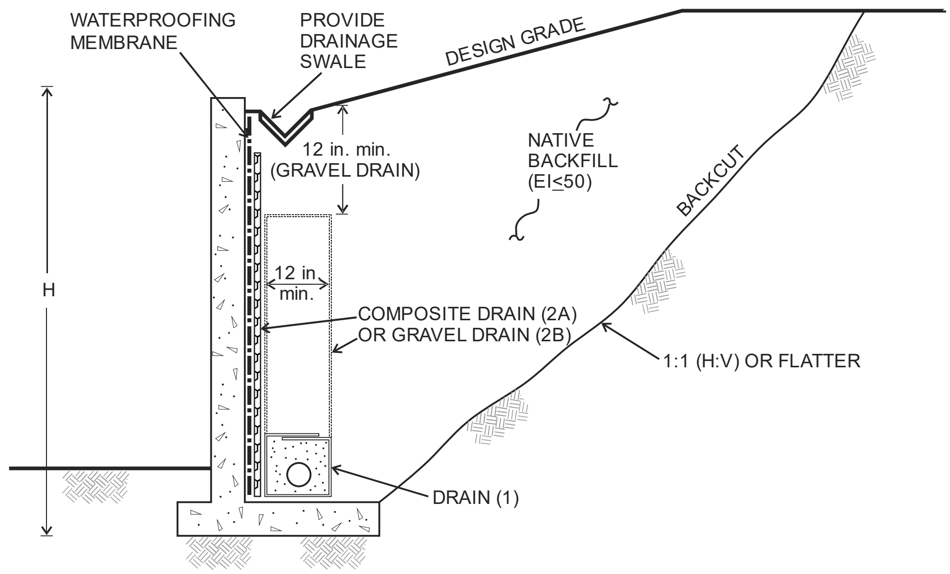
Where:
- Pe = Seismic thrust load
- H = Height of the wall (feet)
- γ = soil density = 130 pounds per cubic foot (pcf)
- k_h = seismic pseudostatic coefficient = 0.5 * peak horizontal ground acceleration / g

The peak horizontal ground accelerations are provided in Section 5.7.3. Walls should be designed to resist the combined effects of static pressures and the above seismic thrust load.

Retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces as shown in Details RTW-A and RTW-B. Otherwise, the retaining walls should be designed to resist hydrostatic forces. Proper drainage devices should be installed along the top of the wall backfill and should be properly sloped to prevent surface water ponding adjacent to the wall. In addition to the wall drainage system, for building perimeter walls extending below the finished grade, the wall should be waterproofed and/or damp-proofed to effectively seal the wall from moisture infiltration through the wall section to the interior wall face.

The wall should be backfilled with granular soils placed in loose lifts no greater than 8 inches thick, at or near optimum moisture content, and mechanically compacted to a minimum 90 percent of the maximum dry density as determined by ASTM D1557. Flooding or jetting of backfill materials generally do not result in the required degree and uniformity of compaction and, therefore, is not recommended. No backfill should be placed against concrete until minimum design strengths are achieved as verified by compression tests of cylinders. The geotechnical consultant should observe the retaining wall footings, back drain installation, and be present during placement of the wall backfill to confirm that the walls are properly backfilled and compacted.





NOTES: (1) DRAIN: 4-INCH PERFORATED ABS OR PVC PIPE OR APPROVED EQUIVALENT SUBSTITUTE PLACED PERFORATIONS DOWN AND SURROUNDED BY A MINIMUM OF 1 CUBIC FEET OF 3/4 INCH ROCK OR APPROVED EQUIVALEN T SUBSTITUTE AND WRAPPED IN MIRAFI 140 FILTER FABRIC OR APPROVED EQUIVALENT SUBSTITUTE

(2A) COMPOSITE DRAIN SYSTEM: MIRAFI G200N, DELTA DRAIN 2000/6000/6200 OR APPROVED EQUIVALENT SUBSTITUTE CONNECTED TO DRAIN (1)

(2B) GRAVEL DRAIN: MINIMUM 12-INCH WIDE 3/4-INCH GRAVEL BLANKET WRAPPED IN MIRAFI FILTER FABRIC (140 OR APPROVED EQUIVALENT SUBSTITUTE)

VER 1.0 NTS

AGS ADVANCED GEOTECHNICAL SOLUTIONS, INC.	RETAINING WALL ALT.B - NATIVE BACKFILL	DETAIL RTW-B

8.2. Civil Design Recommendations

8.2.1. Site Drainage

Final site grading should assure positive drainage away from structures. Planter areas should be provided with area drains to transmit irrigation and rain water away from structures. The use of gutters and down spouts to carry roof drainage well away from structures is recommended. Raised planters should be provided with a positive means to remove water through the face of the containment wall.

8.2.2. Rear and Side Yard Walls and Fences

Block wall footings should be founded a minimum of 24-inches below the lowest adjacent grade. To reduce the potential for uncontrolled, unsightly cracks, it is recommended that a construction joint be incorporated at regular intervals. Spacing of the joints should be between 10 and 20 feet.

8.2.3. Exterior Flatwork

8.2.3.1. *Slab Thickness*

Concrete flatwork should be designed utilizing 4-inch minimum thickness.

8.2.3.2. *Control Joints*

Weakened plane joints should be installed on walkways at intervals of approximately 6 to 8 feet. Exterior slabs should be designed to withstand shrinkage of the concrete.

8.2.3.3. *Flatwork Reinforcement*

Consideration should be given to reinforcing any exterior flatwork.

8.2.3.4. *Thickened Edge*

Consideration should be given to construct a thickened edge (scoop footing) at the perimeter of slabs and walkways adjacent to landscape areas to minimize moisture variation below these improvements. The thickened edge (scoop footing) should extend approximately 8 inches below concrete slabs and should be a minimum of 6 inches wide.

8.2.4. Pavement Design

Preliminary pavement recommendations for streets and driveways are provided below. The performance of pavement is highly dependent on providing positive surface drainage away from the edge of pavement. Ponding of water on or adjacent to the pavement will likely result in pavement distress and subgrade failure. Drainage from landscaped areas should be directed towards controlled drainage structures and not towards pavement areas. Landscaped areas adjacent to pavement areas are not recommended due the potential for surface or irrigation water infiltrating into the aggregate base and pavement subgrade. If landscaped areas are placed adjacent to pavement areas, consideration should be given to implementing measures that will reduce the potential for water to be introduced into the aggregate base. Such measures may include installing impermeable vertical barriers between the landscaped area and pavement areas including deepened curbs or 10 mil thick plastic liners. Such barriers should extend a minimum of 6 inches below the bottom of the aggregate base.

8.2.4.1. *Asphalt Concrete Pavement*

Presented below are preliminary pavement sections for a range of traffic indices and an assumed Resistance-Value (R-Value) of 30 for the subgrade soils. R-Value testing of the subgrade soils should be performed during precise grading operations to verify the assumed R-Value of 30. The project Civil Engineer or Traffic Engineer should select traffic indices that are appropriate for the anticipated pavement usage and level of maintenance desired through the pavement life. Final pavement structural sections will be dependent on the R-value of the subgrade materials and the traffic index for the specific street or area being addressed. The pavement sections are subject to the review and approval of the County of Riverside.

TABLE 8.2.4.1
PRELIMINARY ASPHALT CONCRETE PAVEMENT SECTIONS*

Traffic Index	Assumed R-Value	Asphalt Concrete (inches)	Class II Aggregate Base (inches)
4.5	30	3	5
5.0	30	3	6
5.5	30	3	7
6.0	30	3.5	8
6.5	30	4	8

*Note: See additional recommendations for subgrade preparation below.

If using aggregate base, pavement subgrade soils should be at or near optimum moisture content and should be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D1557. Aggregate base should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D1557 and should conform with the specifications listed in Section 26 of the *Standard Specifications for the State of California Department of Transportation* (Caltrans) or Section 200-2 of the *Standard Specifications for Public Works Construction* (Green Book). The asphalt concrete should conform to Section 26 of the Caltrans *Standard Specifications* or Section 203-6 of the Green Book.

8.3. Corrosion

Resistivity and pH tests should be conducted during grading to evaluate the corrosivity of fill to buried metallic materials. AGS recommends minimally that the current standard of care be employed for protection of metallic construction materials in contact with onsite soils or that consultation with an engineer specializing in corrosion to determine specifications for protection of the construction materials.

9.0 SLOPE AND LOT MAINTENANCE

Maintenance of improvements is essential to the long-term performance of structures and slopes. Although the design and construction during mass grading created slopes that are considered both grossly and surficially stable, certain factors are beyond the control of the soil engineer and geologist. The homeowners must implement certain maintenance procedures.

In addition to the appended Homeowners Maintenance Guidelines, the following recommendations should be implemented.

9.1. Slope Planting

Slope planting should consist of ground cover, shrubs and trees that possess deep, dense root structures and require a minimum of irrigation. The resident should be advised of their responsibility to maintain such planting.

9.2. Lot Drainage

Roof, pad and lot drainage should be collected and directed away from structures and slopes and toward approved disposal areas. Design fine-grade elevations should be maintained through the life of the structure, or if design fine grade elevations are altered, adequate area drains should be installed in order to provide rapid discharge of water away from structures and slopes. Residents should be made aware that they are responsible for maintenance and cleaning of all drainage terraces, downdrains, and other devices that have been installed to promote structure and slope stability.

9.3. Slope Irrigation

The resident, homeowner and Homeowner Association should be advised of their responsibility to maintain irrigation systems. Leaks should be repaired immediately. Sprinklers should be adjusted to provide maximum uniform coverage with a minimum of water usage and overlap. Overwatering with consequent wasteful run-off and ground saturation should be avoided. If automatic sprinkler systems are installed, their use must be adjusted to account for natural rainfall conditions.

9.4. Burrowing Animals

Residents or homeowners should undertake a program for the elimination of burrowing animals. This should be an ongoing program in order to maintain slope stability.

10.0 FUTURE STUDY NEEDS

10.1. In-Grading Observation

Geologic exposures afforded during remedial and rough grading operations provide the best opportunity to evaluate the anticipated site geologic structure. Continuous geologic and geotechnical observations, testing, and mapping should be provided throughout site development. Additional near-surface samples should be collected by the geotechnical consultant during grading and subjected to laboratory testing. Final design recommendations should be provided in a grading report based on the observation and test results collected during grading.

11.0 CLOSURE

11.1. Geotechnical Review

As is the case in any grading project, multiple working hypotheses are established utilizing the available data, and the most probable model is used for the analysis. Information collected during the grading and construction operations is intended to evaluate the hypotheses, and some of the assumptions summarized herein may need to be changed as more information becomes available. Some modification of the grading and construction recommendations may become necessary, should the conditions encountered in the field differ significantly than those hypothesized to exist.

AGS should review the pertinent plans and sections of the project specifications, to evaluate conformance with the intent of the recommendations contained in this report.

If the project description or final design varies from that described in this report, AGS must be consulted regarding the applicability of, and the necessity for, any revisions to the recommendations presented herein. AGS accepts no liability for any use of its recommendations if the project description or final design varies and AGS is not consulted regarding the changes.

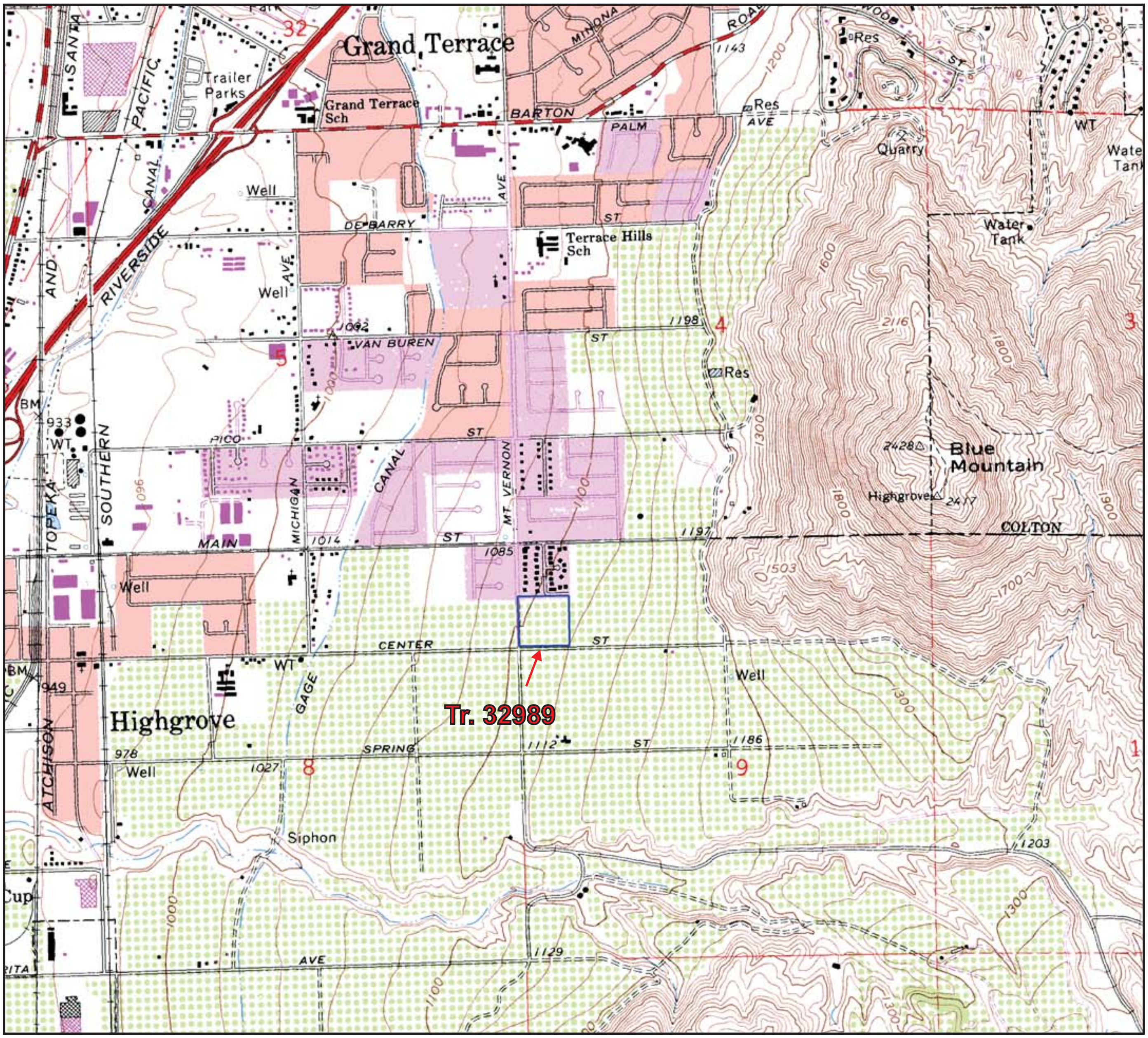
11.2. Limitations

This report is based on the project as described and the information obtained from referenced reports and the exploratory excavations at the locations indicated on the plans. The findings are based on the review of the field and laboratory data combined with an interpolation and extrapolation of conditions between and beyond the exploratory excavations. The results reflect an interpretation of the direct evidence obtained. Services performed by AGS have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, either expressed or implied, and no warranty or guarantee is included or intended.

The recommendations presented in this report are based on the assumption that an appropriate level of field review will be provided by geotechnical engineers and engineering geologists who are familiar with the design and site geologic conditions. That field review shall be sufficient to confirm that geotechnical and geologic conditions exposed during grading are consistent with the geologic representations and corresponding recommendations presented in this report. AGS should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations of this report are applicable to the specific design of this project as discussed in this report. They have no applicability to any other project or to any other location, and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of AGS.

AGS has no responsibility for construction means, methods, techniques, sequences, or procedures, or for safety precautions or programs in connection with the construction, for the acts or omissions of the CONTRACTOR, or any other person performing any of the construction, or for the failure of any of them to carry out the construction in accordance with the final design drawings and specifications.



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SCALE: 1 in. = 2000 ft.

U.S.G.S. SITE LOCATION MAP
TRACT 32989
HIGHGROVE AREA
COUNTY OF RIVERSIDE, CALIFORNIA

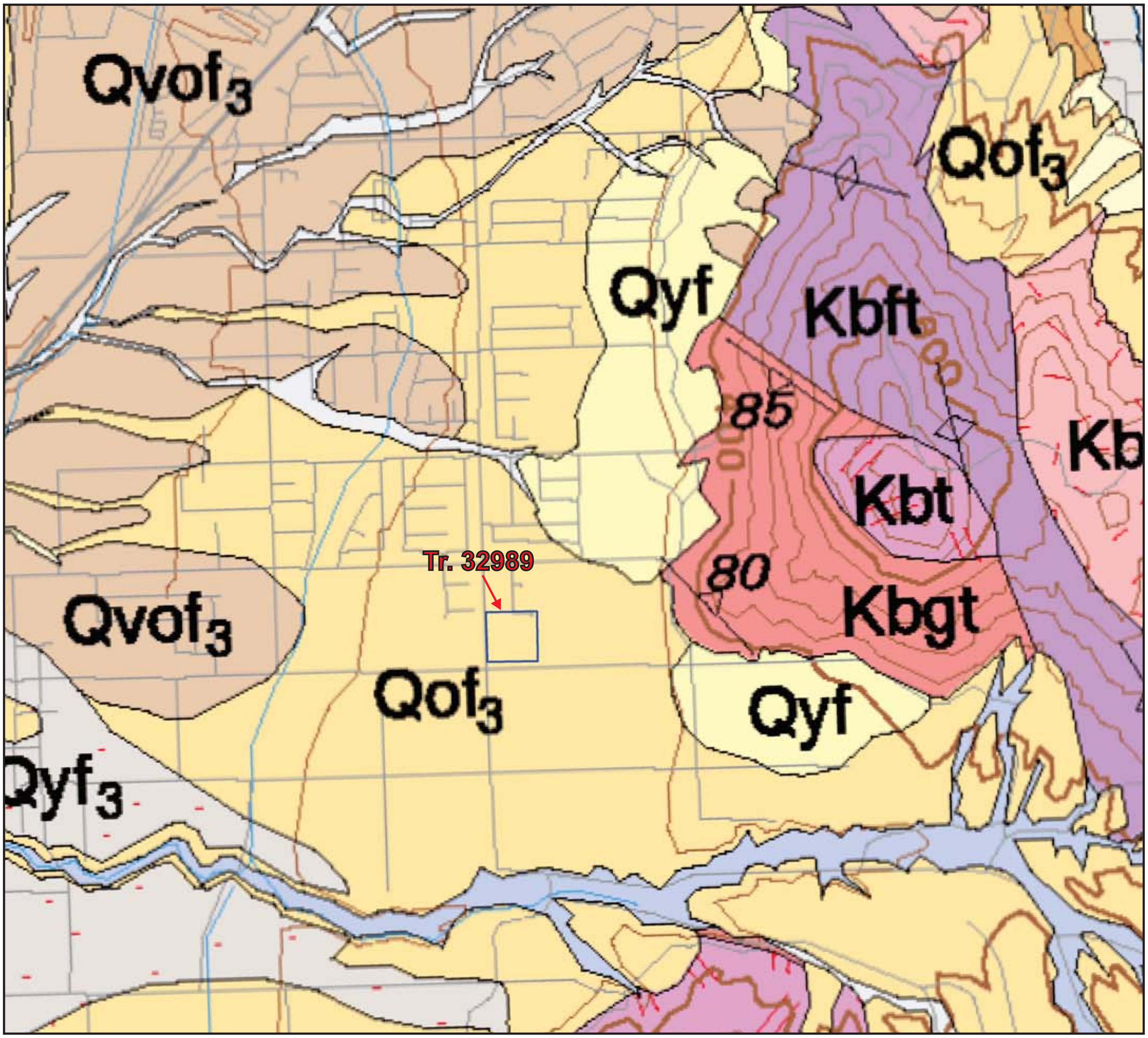
Latitude: 34.0166° N
Longitude: -117.3124° W

FIGURE 1

SOURCE MAP(S): San Bernardino South U.S.G.S. 7.5-minute Quadrangle

AGS
ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Ste B, Escondido, California 92029
Telephone: (619) 867-0487 Fax: (714) 409-3287

P/W 1612-03 **Report No. 1612-03-B-1**

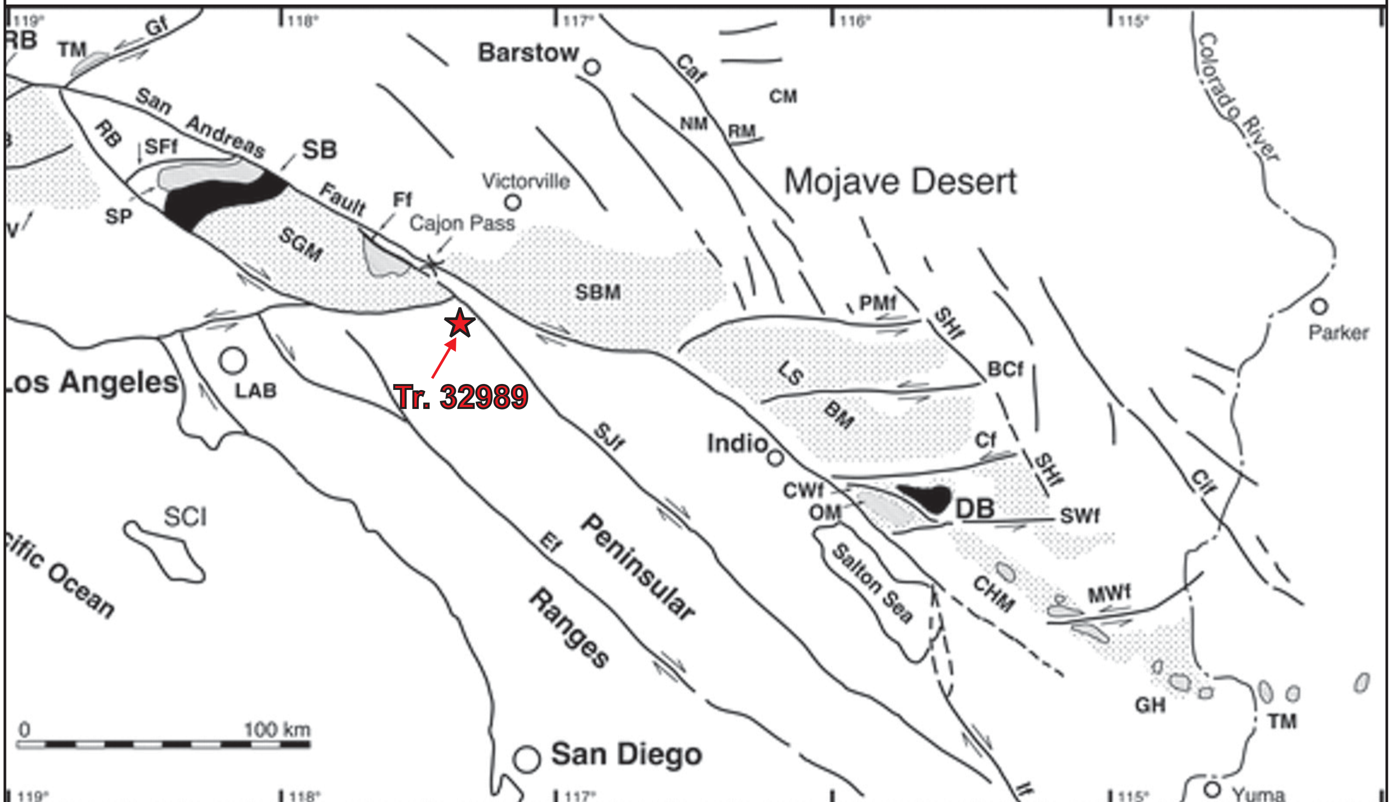


REGIONAL GEOLOGIC MAP
TRACT 32989
HIGHGROVE AREA
COUNTY OF RIVERSIDE, CALIFORNIA

FIGURE 2

SOURCE MAP(S): USGS 2003, Preliminary Geologic Map of the 30'x60' San Bernardino Quadrangle

AGS
ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Ste B, Escondido, California 92029
Telephone: (619) 867-0487 Fax: (714) 409-3287
P/W 1612-03 **Report No. 1612-03-B-1**



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FAULT MAP
TRACT 32989
HIGHGROVE AREA
COUNTY OF RIVERSIDE, CALIFORNIA

FIGURE 3

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ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Ste B, Escondido, California 92029
Telephone: (619) 867-0487 Fax: (714) 409-3287
P/W 1612-03 **Report No. 1612-03-B-1**

APPENDIX A

REFERENCES

APPENDIX A

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APPENDIX B

SUBSURFACE LOGS AND LABORATORY RESULTS BY OTHERS

(SSI 2005)

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-1

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
	Bulk/Grab							Weeds
					SP-SM		0	Sand - Lt brn, silty, dry, fine to med., pebbles, slighlty porous (Max 133 pcf @ 9.0%)
							2	
	California	4.0	107	80				
							4	
7	SPT							
					SP		6	- Lt brn, slightly silty, fine to med. coarse, pebbles, rock frag., slightly porous
							8	
	California	4.5	120	90				
							10	
20	SPT							- Lt brn, slightly silty, fine to med., pebbles
							12	

Groundwater: None
Approx. Depth of Bedrock: None
Datum: N/A
Elevation: N/A

Site Location
NEC Center & Mt Vernon
Riverside County

Plate #

Bulk/Grab sample — California sampler — Standard penetration test

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-1

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
							14	
25								
							16	
							18	
							20	
27								- Yellow brn, fine to med. coarse, rock frag.
							22	
							24	
23								
							26	
							28	
								- Lt brn, fine to med. coarse, pebbles,

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-1

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
								rock frag.
							30	
24								
								- End of boring @ 31' No bedrock No groundwater
							32	
							34	
							36	
							38	
							40	
							42	
							44	

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-2

Project: Victoria Homes / Tr.32989		**Job No.:**	05156-F
Logged By: John	**Boring Diam.:** 8"	**Date:**	29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
					SP		0	Weeds
								Sand - Brn, dry, fine to med., pebbles, slighlty porous, slightly silty
							2	
10	Standard penetration test						3	
							4	
	California sampler	8.0	117	88			5	
							6	
							8	
27	Standard penetration test						8.5	
							10	
							12	
								- Lt brn, fine to med. coarse, pebbles, rock frag.
12	Standard penetration test						13.5	

Groundwater: None
Approx. Depth of Bedrock: None
Datum: N/A
Elevation: N/A

Site Location
NEC Center & Mt Vernon
Riverside County

Plate #

Bulk/Grab sample — California sampler — Standard penetration test

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-2

Project: Victoria Homes / Tr.32989		**Job No.:** 05156-F	
Logged By: John	**Boring Diam.:** 8"	**Date:** 29 Jun 05	

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
							14	
								- Lt brn, med. to coarse
							16	
							18	
25								
					SP-SM			- Lt brn, silty, fine to med., pebbles
							20	
								- End of boring @ 20' No bedrock No groundwater
							22	
							24	
							26	
							28	

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-3

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
								Weeds
					SP			Sand - Brn, slightly silty, dry, fine to med., pebbles, slightly porous
							2	
							4	
18	Standard penetration test							
							6	
							8	
16	Standard penetration test							- Scattered rock 1", moist
							10	
							12	

Groundwater: None
Approx. Depth of Bedrock: None
Datum: N/A
Elevation: N/A

Site Location
NEC Center & Mt Vernon
Riverside County

Plate #

Bulk/Grab sample | California sampler | Standard penetration test

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-3

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
							14	
27					SP-SM			- Lt brn, silty, moist, fine to med., coarse, pebbles, rock frag.
							16	- End of boring @ 16' No bedrock No groundwater
							18	
							20	
							22	
							24	
							26	
							28	

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-4

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
								Weeds
					SP		0	Sand - Brn, slightly silty, dry, fine to med., pebbles, slighlty porous
3	Standard penetration test						2	- Very loose
							4	
							6	
6	Standard penetration test				SP-SM		7	- Brn, silty, fine to med. coarse, moist
							8	
					SP		9	- Gray brn, fine to med. coarse, rock frag., pebbles, moist, slightly silty
							10	
	California sampler	8.0	126	95				
							12	

Groundwater: None	Site Location	Plate #
Approx. Depth of Bedrock: None		
Datum: N/A	NEC Center & Mt Vernon	
Elevation: N/A	Riverside County	

Bulk/Grab sample · California sampler · Standard penetration test

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-4

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
							14	- Lt brn, slightly silty, fine to med. coarse, pebbles, rock frag.
27								
							16	
								- End of boring @ 16' No bedrock No groundwater
							18	
							20	
							22	
							24	
							26	
							28	

KEY TO SYMBOLS

Symbol Description

Strata symbols

Symbol	Description
(pattern)	Poorly graded sand with silt
(pattern)	Poorly graded sand

Soil Samplers

Symbol	Description
(symbol)	Bulk/Grab sample
(symbol)	California sampler
(symbol)	Standard penetration test

Notes:

1. Exploratory borings were drilled on 29 Jun 05 using a 4-inch diameter continuous flight power auger.
2. No free water was encountered at the time of drilling or when re-checked the following day.
3. Boring locations were taped from existing features and elevations extrapolated from the final design schematic plan.
4. These logs are subject to the limitations, conclusions, and recommendations in this report.
5. Results of tests conducted on samples recovered are reported on the logs.

8.0 APPENDIX B

Laboratory Test Programs

Laboratory tests were conducted on representative soils for the purpose of classification and for the determination of the physical properties and engineering characteristics. The number and selection of the types of testing for a given study are based on the geotechnical conditions of the site. A summary of the various laboratory tests performed for the project is presented below.

Moisture Content and Dry Density (D2937):

Data obtained from these test, performed on undisturbed samples are used to aid in the classification and correlation of the soils and to provide qualitative information regarding soil strength and compressibility.

Direct Shear (D3080):

Data obtained from this test performed at increased and field moisture conditions on relatively remolded soil sample is used to evaluate soil shear strengths. Samples contained in brass sampler rings, placed directly on test apparatus are sheared at a constant strain rate of 0.002 inch per minute under saturated conditions and under varying loads appropriate to represent anticipated structural loadings. Shearing deformations are recorded to failure. Peak and/or residual shear strengths are obtained from the measured shearing load versus deflection curve. Test results, plotted on graphical form, are presented on Plate B-1 of this section.

Consolidation (D2835):

Drive-tube samples are tested at their field moisture contents and at increased moisture conditions since the soils may become saturated during life-time use of the planned structure.

Data obtained from this test performed on relatively undisturbed and/or remolded samples, were used to evaluate the consolidation characteristics of foundation soils under anticipated foundation loadings. Preparation for this test involved trimming the sample, placing it in one inch high brass ring, and loading it into the test apparatus which contained porous stones to accommodate drainage during testing. Normal axial loads are applied at a load increment ratio, successive loads being generally twice the preceding.

Soil samples are usually under light normal load conditions to accommodate seating of the apparatus. Samples were tested at the field moisture conditions at a predetermined normal load. Potentially moisture sensitive soil typically demonstrated significant volume change with the introduction of free water. The results of the consolidation tests are presented in graphical forms on Plate B-2.

Potential Expansion

Considering sandy nature, the site soils are considered non-expansive in contact with water, and consequently, no expansion tests are performed and none such are considered necessary at this time.

Laboratory Test Results

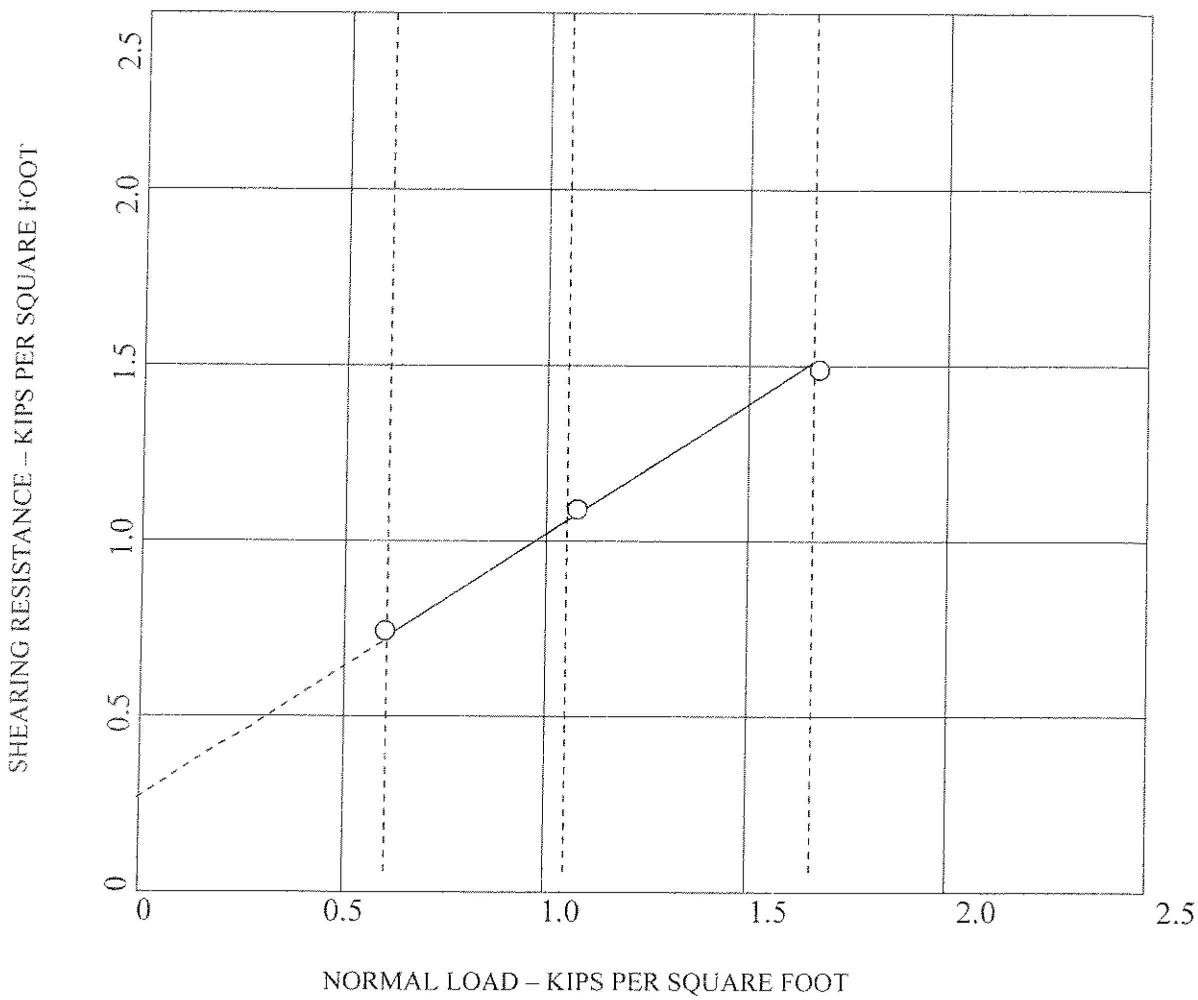
Table I: In-Situ Moisture-Density

Test Boring No.	Sample Depth, ft.	Dry Density, pcf.	Moisture Content, %
1	3.0	107	4.0
1	8.0	120	4.5
2	5.0	117	8.0
4	10.0	126	8.0

Table III: Max. Density/Optimum Moisture Content (ASTM D1557-91)

Sample Location, @ Depth, ft.	Max. Dry Density, pcf	Opt. Moisture (%)
B-1 @ 0-3	133	9.0

DIRECT SHEAR TESTS

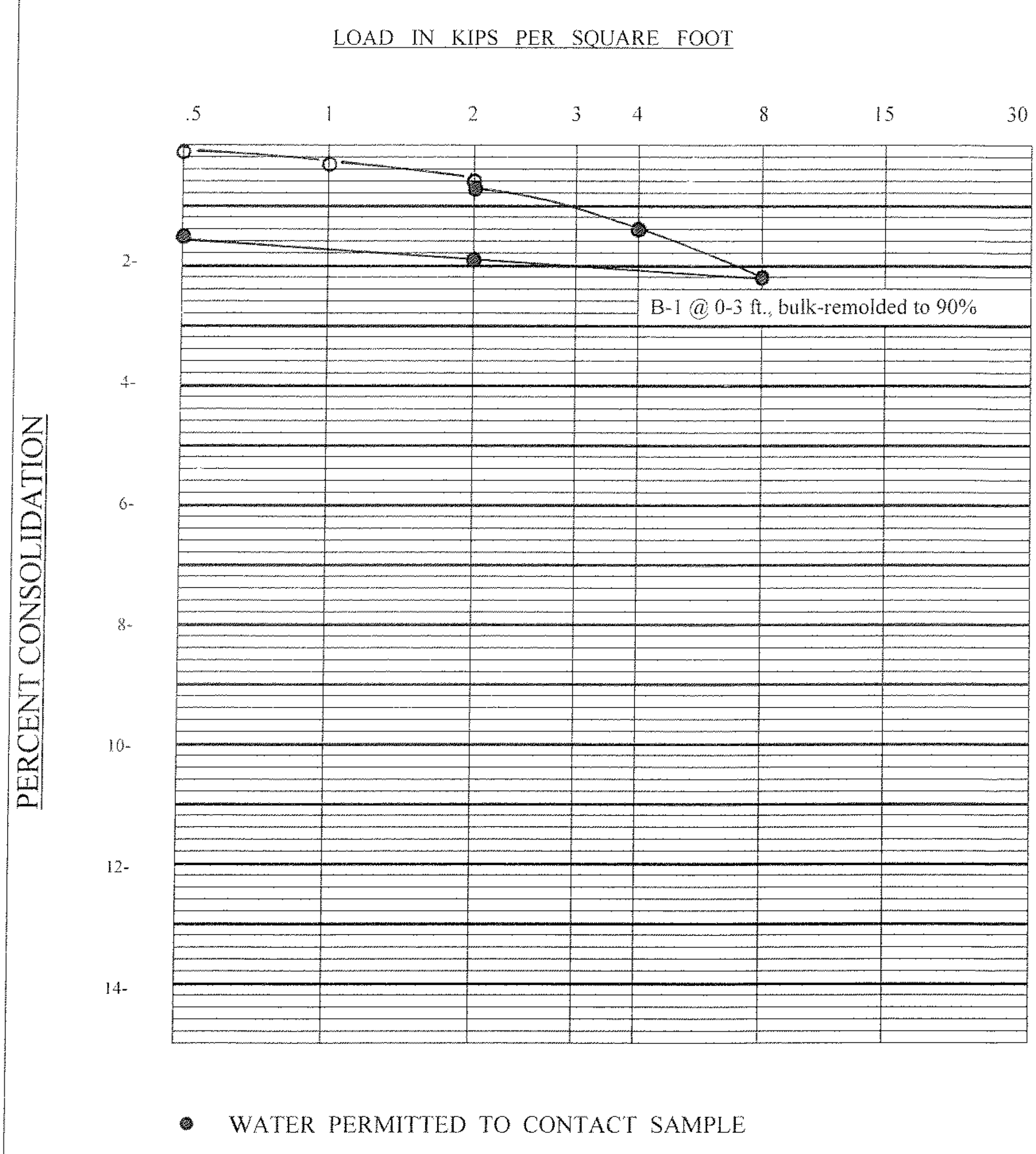


SYMBOL	LOCATION	DEPTH (ft)	TEST CONDITION	COHESION (psf)	FRICTION (degree)
○	B-1	0-3	Bulk-remolded to 90%	275	33

Proposed Single Family Tract 32989 NEC Center Street & Mt Vernon Avenue Highgrove area, Riverside County, California	PROJECT NO.	05156-F
	PLATE	B-1

SOILS SOUTHWEST INC.
Consulting Foundation Engineers

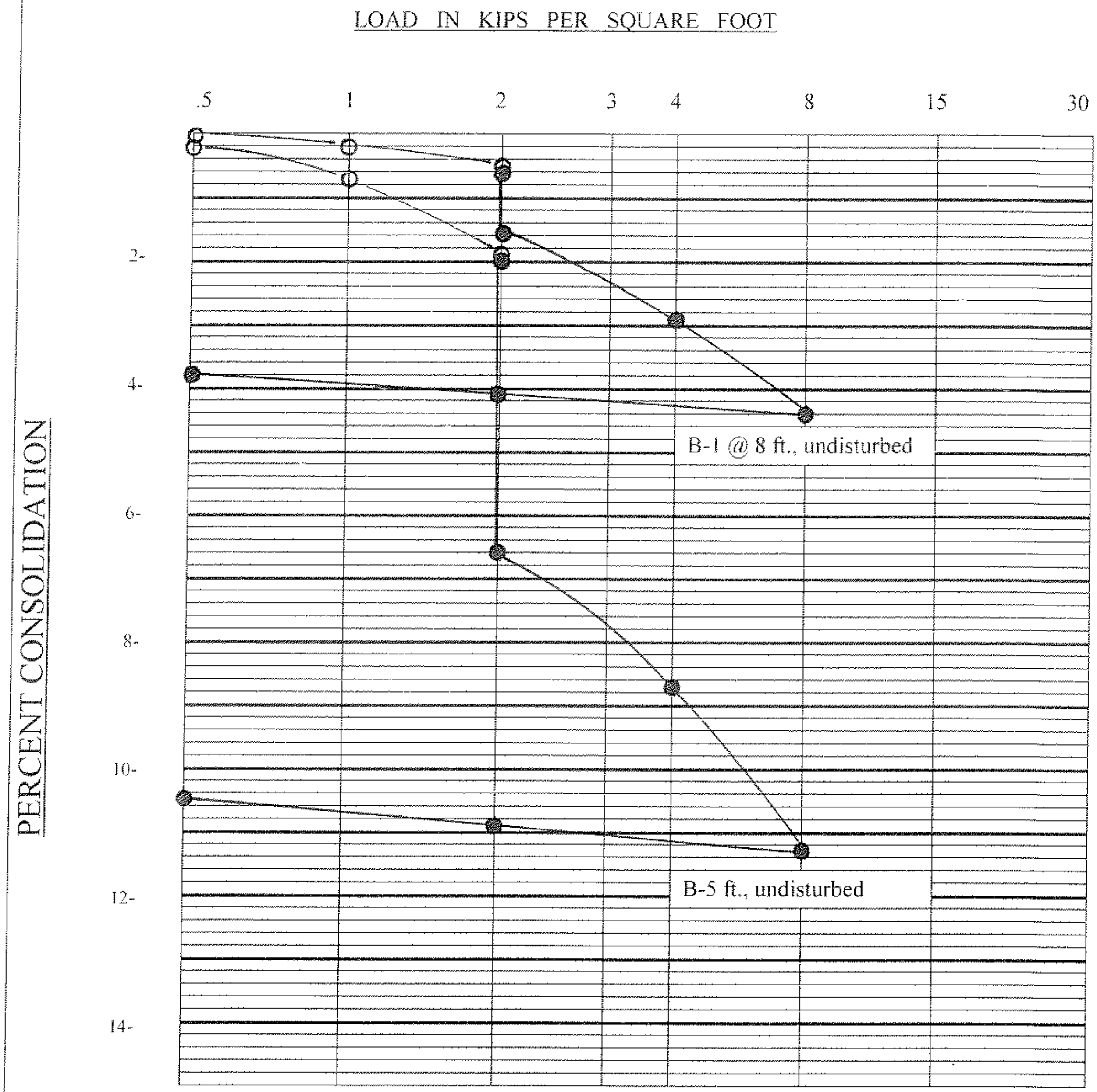
CONSOLIDATION TESTS



Proposed Single Family Tract 32989 NEC Center Street & Mt Vernon Avenue Highgrove area, Riverside County, California	PROJECT NO.	05156-F
	PLATE	B-2

SOILS SOUTHWEST INC.
Consulting Foundation Engineers

CONSOLIDATION TESTS



● WATER PERMITTED TO CONTACT SAMPLE

Proposed Single Family Tract 32989 NEC Center Street & Mt Vernon Avenue Highgrove area, Riverside County, California	PROJECT NO.	05156-F
	PLATE	B-2-1

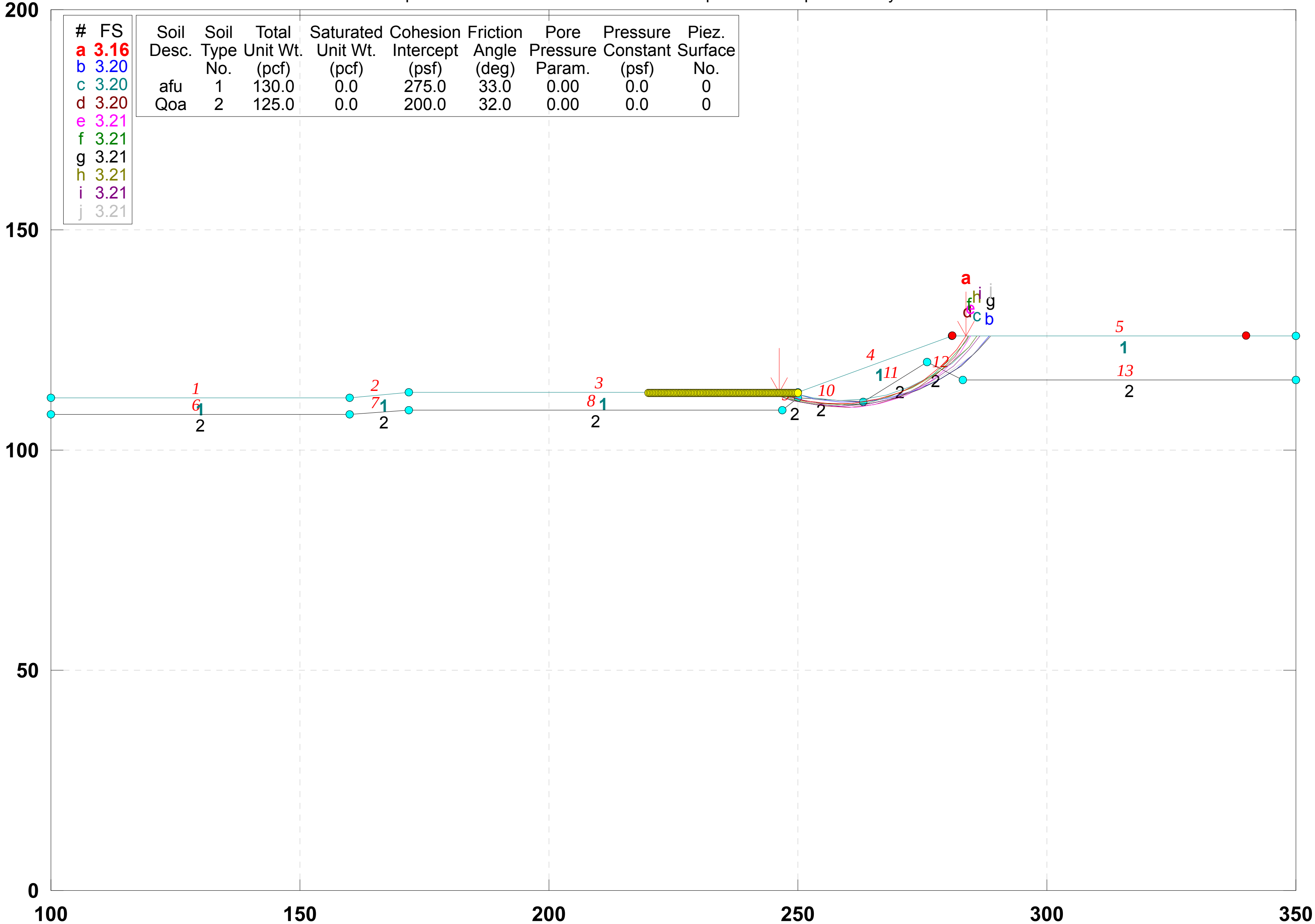
SOILS SOUTHWEST INC.
Consulting Foundation Engineers

APPENDIX C

SLOPE STABILITY ANALYSIS

1612-03 15' Cut Slope Static

c:\users\nick\desktop\shane smith\1601-04 cavallo street duplex\-newfile.pl2 Run By: SS 1/6/2017 02:37PM



Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
afu	1	130.0	0.0	275.0	33.0	0.00	0.0	0
Qoa	2	125.0	0.0	200.0	32.0	0.00	0.0	0

GSTABL7 v.2 FSmin=3.16

Safety Factors Are Calculated By The Modified Bishop Method

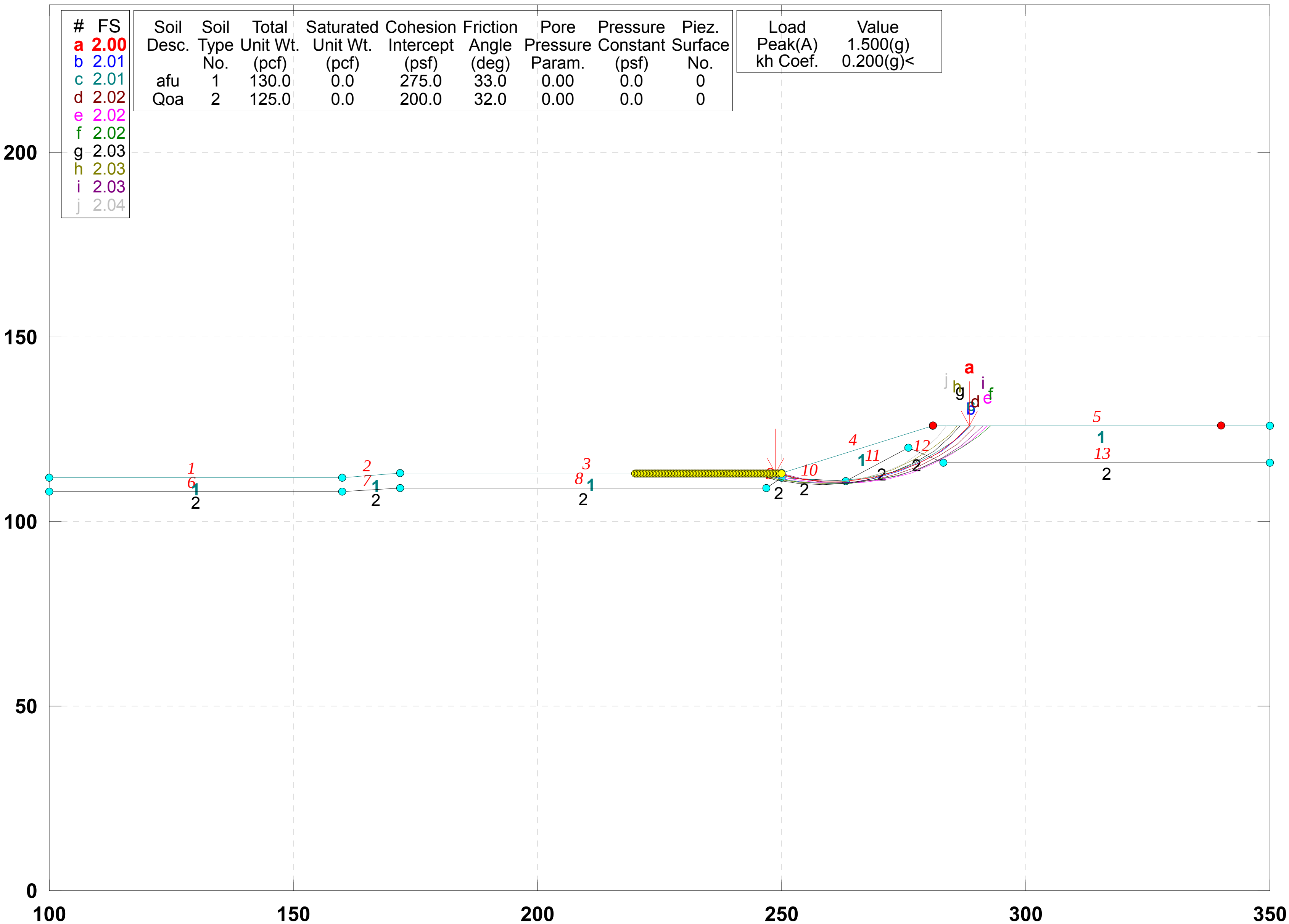
1612-03 15' Cut Slope Pseudo Static

c:\users\nick\desktop\shane smith\1601-04 cavallo street duplex\1612-03 highgrove cut slope psuedo static.pl2 Run By: SS 1/6/2017 02:45PM

#	FS
a	2.00
b	2.01
c	2.01
d	2.02
e	2.02
f	2.02
g	2.03
h	2.03
i	2.03
j	2.04

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
afu	1	130.0	0.0	275.0	33.0	0.00	0.0	0
Qoa	2	125.0	0.0	200.0	32.0	0.00	0.0	0

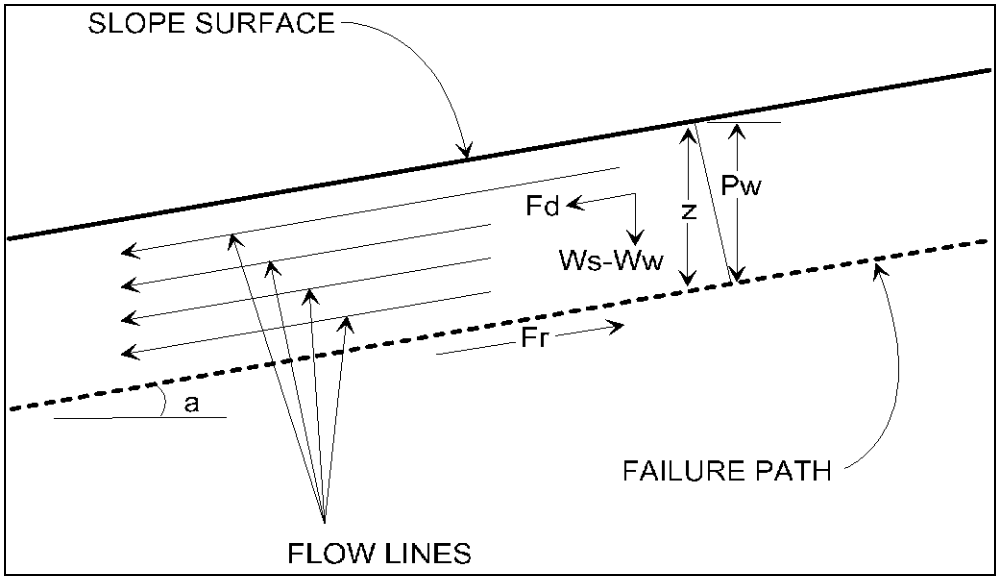
Load	Value
Peak(A)	1.500(g)
kh Coef.	0.200(g)<



GSTABL7 v.2 FSmin=2.00

Safety Factors Are Calculated By The Modified Bishop Method

SURFICIAL STABILITY ANALYSIS



Assume: (1) Saturation To Slope Surface
(2) Sufficient Permeability To Establish Water Flow

Pw = Water Pressure Head=(z)(cos^2(a))
Ws = Saturated Soil Unit Weight
Ww = Unit Weight of Water (62.4 lb/cu.ft.)
u = Pore Water Pressure=(Ww)(z)(cos^2(a))
z = Layer Thickness
a = Angle of Slope
phi = Angle of Friction
c = Cohesion
Fd = (0.5)(z)(Ws)(sin(2a))
Fr = (z)(Ws-Ww)(cos^2(a))(tan(phi)) + c
Factor of Safety (FS) = Fr/Fd

2:1 CUT SLOPE

Given:

Ws	z	a		phi		c
(pcf)	(ft)	(degrees)	(radians)	(degrees)	(radians)	(psf)
130	4	26.56505	0.463648	33	0.575959	275

Calculations:

Pw	u	Fd	Fr	**FS**
3.20	199.68	208.00	415.48	**2.00**

Special Cases:

Saturated Sand: FS = (Ww/Ws)(tan(phi')/tan(a))
FS = 0.369568

Moist Clay FS = (c/Ws*z)(1/(cos^2(a)*tan(a))
FS = 1.322115

APPENDIX D

GENERAL EARTHWORK SPECIFICATIONS AND GRADING DETAILS

GENERAL EARTHWORK SPECIFICATIONS

I. General

A. General procedures and requirements for earthwork and grading are presented herein. The earthwork and grading recommendations provided in the geotechnical report are considered part of these specifications, and where the general specifications provided herein conflict with those provided in the geotechnical report, the recommendations in the geotechnical report shall govern. Recommendations provided herein and in the geotechnical report may need to be modified depending on the conditions encountered during grading.

B. The contractor is responsible for the satisfactory completion of all earthwork in accordance with the project plans, specifications, applicable building codes, and local governing agency requirements. Where these requirements conflict, the stricter requirements shall govern.

C. It is the contractor's responsibility to read and understand the guidelines presented herein and in the geotechnical report as well as the project plans and specifications. Information presented in the geotechnical report is subject to verification during grading. The information presented on the exploration logs depict conditions at the particular time of excavation and at the location of the excavation. Subsurface conditions present at other locations may differ, and the passage of time may result in different subsurface conditions being encountered at the locations of the exploratory excavations. The contractor shall perform an independent investigation and evaluate the nature of the surface and subsurface conditions to be encountered and the procedures and equipment to be used in performing his work.

D. The contractor shall have the responsibility to provide adequate equipment and procedures to accomplish the earthwork in accordance with applicable requirements. When the quality of work is less than that required, the Geotechnical Consultant may reject the work and may recommend that the operations be suspended until the conditions are corrected.

E. Prior to the start of grading, a qualified Geotechnical Consultant should be employed to observe grading procedures and provide testing of the fills for conformance with the project specifications, approved grading plan, and guidelines presented herein. All clearing and grubbing, remedial removals, clean-outs, removal bottoms, keyways, and subdrain installations should be observed and documented by the Geotechnical Consultant prior to placing fill. It is the contractor's responsibility to apprise the Geotechnical Consultant of their schedules and notify the Geotechnical Consultant when those areas are ready for observation.

F. The contractor is responsible for providing a safe environment for the Geotechnical Consultant to observe grading and conduct tests.

II. Site Preparation

A. Clearing and Grubbing: Excessive vegetation and other deleterious material shall be sufficiently removed as required by the Geotechnical Consultant, and such materials shall be properly disposed of offsite in a method acceptable to the owner and governing agencies. Where applicable, the contractor may obtain permission from the Geotechnical Consultant, owner, and governing agencies to dispose of vegetation and other deleterious materials in designated areas onsite.

B. Unsuitable Soils Removals: Earth materials that are deemed unsuitable for the support of fill shall be removed as necessary to the satisfaction of the Geotechnical Consultant.

C. Any underground structures such as cesspoles, cisterns, mining shafts, tunnels, septic tanks, wells, pipelines, other utilities, or other structures located within the limits of grading shall be removed and/or abandoned in accordance with the requirements of the governing agency and to the satisfaction of the Geotechnical Consultant. Environmental evaluation of existing conditions is not the responsibility of the Geotechnical Consultant.

D. Preparation of Areas to Receive Fill: After removals are completed, the exposed surfaces shall be processed or scarified to a depth of approximately 8 inches, watered or dried, as needed, to achieve a generally uniform moisture content that is at or near optimum moisture content. The scarified materials shall then be compacted to the project requirements and tested as specified.

E. All areas receiving fill shall be observed and approved by the Geotechnical Consultant prior to the placement of fill. A licensed surveyor shall provide survey control for determining elevations of processed areas and keyways.

III. Placement of Fill

A. Suitability of fill materials: Any materials, derived onsite or imported, may be utilized as fill provided that the materials have been determined to be suitable by the Geotechnical Consultant. Such materials shall be essentially free of organic matter and other deleterious materials, and be of a gradation, expansion potential, and/or strength that is acceptable to the Geotechnical Consultant. Fill materials shall be tested in a laboratory approved by the Geotechnical Consultant, and import materials shall be tested and approved prior to being imported.

B. Generally, different fill materials shall be thoroughly mixed to provide a relatively uniform blend of materials and prevent abrupt changes in material type. Fill materials derived from benching should be dispersed throughout the fill area instead of placing the materials within only an equipment-width from the cut/fill contact.

C. Oversize Materials: Rocks greater than 12 inches in largest dimension shall be disposed of offsite or be placed in accordance with the recommendations by the Geotechnical Consultant in the areas that are designated as suitable for oversize rock placement. Rocks that are smaller than 8 inches in largest dimension may be utilized in the fill provided that they are not nested and are their quantity and distribution are acceptable to the Geotechnical Consultant and do not inhibit the ability to properly compact fill materials.

D. The fill materials shall be placed in thin, horizontal layers such that, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and shall be thoroughly mixed to obtain a near uniform moisture content and uniform blend of materials.

E. Moisture Content: Fill materials shall be placed at or above the optimum moisture content or as recommended by the geotechnical report. Where the moisture content of the engineered fill is less than recommended, water shall be added, and the fill materials shall be blended so that a near uniform moisture content is achieved. If the moisture content is above the limits specified by the Geotechnical Consultant, the fill materials shall be aerated by discing, blading, or other methods until the moisture content is acceptable.

F. Each layer of fill shall be compacted to the project standards in accordance to the project specifications and recommendations of the Geotechnical Consultant. Unless otherwise specified by the Geotechnical Consultant, the fill shall be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM Test Method: D1557.

G. Benching: Where placing fill on a slope exceeding a ratio of 5 to 1 (horizontal to vertical), the ground should be keyed or benched. The keyways and benches shall extend through all unsuitable materials into suitable materials such as firm materials or sound bedrock or as recommended by the Geotechnical Consultant. The minimum keyway width shall be 15 feet and extend into suitable materials, or as recommended by the geotechnical report and approved by the Geotechnical Consultant. The minimum keyway width for fill over cut slopes is also 15 feet, or as recommended by the geotechnical report and approved by the Geotechnical Consultant. As a general rule, unless otherwise recommended by the Geotechnical Consultant, the minimum width of the keyway shall be equal to ½ the height of the fill slope.

H. Slope Face: The specified minimum relative compaction shall be maintained out to the finish face of fill and stabilization fill slopes. Generally, this may be achieved by overbuilding the slope and cutting back to the compacted core. The actual amount of overbuilding may vary as field conditions dictate. Alternately, this may be achieved by backrolling the slope face with suitable equipment or other methods that produce the designated result. Loose soil should not be allowed to build up on the slope face. If present, loose soils shall be trimmed to expose the compacted slope face.

I. Slope Ratio: Unless otherwise approved by the Geotechnical Consultant and governing agencies, permanent fill slopes shall be designed and constructed no steeper than 2 to 1 (horizontal to vertical).

J. Natural Ground and Cut Areas: Design grades that are in natural ground or in cuts should be evaluated by the Geotechnical Consultant to determine whether scarification and processing of the ground and/or overexcavation is needed.

K. Fill materials shall not be placed, spread, or compacted during unfavorable weather conditions. When grading is interrupted by rain, filing operations shall not resume until the Geotechnical Consultant approves the moisture and density of the previously placed compacted fill.

IV. Cut Slopes

A. The Geotechnical Consultant shall observe all cut slopes, including fill over cut slopes, and shall be notified by the contractor when cut slopes are started.

B. If adverse or potentially adverse conditions are encountered during grading, the Geotechnical Consultant shall investigate, evaluate, and make recommendations to mitigate the adverse conditions.

C. Unless otherwise stated in the geotechnical report, cut slopes shall not be excavated higher or steeper than the requirements of the local governing agencies. Short-term stability of the cut slopes and other excavations is the contractor's responsibility.

V. Drainage

A. Backdrains and Subdrains: Backdrains and subdrains shall be provided in fill as recommended by the Geotechnical Consultant and shall be constructed in accordance with the governing agency and/or recommendations of the Geotechnical Consultant. The location of subdrains, especially outlets, shall be surveyed and recorded by the Civil Engineer.

B. Top-of-slope Drainage: Positive drainage shall be established away from the top of slope. Site drainage shall not be permitted to flow over the tops of slopes.

C. Drainage terraces shall be constructed in compliance with the governing agency requirements and/or in accordance with the recommendations of the Civil Engineer.

D. Non-erodible interceptor swales shall be placed at the top of cut slopes that face the same direction as the prevailing drainage.

VI. Erosion Control

A. All finish cut and fill slopes shall be protected from erosion and/or planted in accordance with the project specifications and/or landscape architect's recommendations. Such measures to protect the slope face shall be undertaken as soon as practical after completion of grading.

B. During construction, the contractor shall maintain proper drainage and prevent the ponding of water. The contractor shall take remedial measures to prevent the erosion of graded areas until permanent drainage and erosion control measures have been installed.

VII. Trench Excavation and Backfill

A. Safety: The contractor shall follow all OSHA requirements for safety of trench excavations. Knowing and following these requirements is the contractor's responsibility. All trench excavations or open cuts in excess of 5 feet in depth shall be shored or laid back. Trench excavations and open cuts exposing adverse geologic conditions may require further evaluation by the Geotechnical Consultant. If a contractor fails to provide safe access for compaction testing, backfill not tested due to safety concerns may be subject to removal.

B. Bedding: Bedding materials shall be non-expansive and have a Sand Equivalent greater than 30. Where permitted by the Geotechnical Consultant, the bedding materials can be densified by jetting.

C. Backfill: Jetting of backfill materials to achieve compaction is generally not acceptable. Where permitted by the Geotechnical Consultant, the bedding materials can be densified by jetting provided the backfill materials are granular, free-draining and have a Sand Equivalent greater than 30.

VIII. Geotechnical Observation and Testing During Grading

A. Compaction Testing: Fill will be tested and evaluated by the Geotechnical Consultant for evaluation of general compliance with the recommended compaction and moisture conditions. The tests shall be taken in the compacted soils beneath the surface if the surficial materials are disturbed. The contractor shall assist the Geotechnical Consultant by excavating suitable test pits for testing of compacted fill.

B. Where tests indicate that the density of a layer of fill is less than required, or the moisture content is not within specifications, the Geotechnical Consultant shall notify the contractor of the unsatisfactory conditions of the fill. The portions of the fill that are not within specifications shall be reworked until the required density and/or moisture content has been attained. No additional fill shall be placed until the last lift of fill is tested and found to meet the project specifications and approved by the Geotechnical Consultant.

C. If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as adverse weather, excessive rock or deleterious materials being placed in the fill, insufficient equipment, excessive rate of fill placement, results in a quality of work that is unacceptable, the consultant shall notify the contractor, and the contractor shall rectify the conditions, and if necessary, stop work until conditions are satisfactory.

D. Frequency of Compaction Testing: The location and frequency of tests shall be at the Geotechnical Consultant's discretion. Generally, compaction tests shall be taken at intervals approximately two feet in fill height.

E. Compaction Test Locations: The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of the compaction test locations. The contractor shall coordinate with the surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations. Alternately, the test locations can be surveyed and the results provided to the Geotechnical Consultant.

F. Areas of fill that have not been observed or tested by the Geotechnical Consultant may have to be removed and recompacted at the contractor's expense. The depth and extent of removals will be determined by the Geotechnical Consultant.

G. Observation and testing by the Geotechnical Consultant shall be conducted during grading in order for the Geotechnical Consultant to state that, in his opinion, grading has been completed in accordance with the approved geotechnical report and project specifications.

H. Reporting of Test Results: After completion of grading operations, the Geotechnical Consultant shall submit reports documenting their observations during construction and test results. These reports may be subject to review by the local governing agencies.

APPENDIX E

HOMEOWNERS MAINTENANCE GUIDELINES

HOMEOWNERS MAINTENANCE GUIDELINES

Homeowners are accustomed to maintaining their homes. They expect to paint their houses periodically, replace wiring, clean out clogged plumbing, and repair roofs. Maintenance of the home site, particularly on hillsides, should be considered on the same basis, or even on a more serious basis because neglect can result in serious consequences. In most cases, lot and site maintenance can be taken care of along with landscaping, and can be carried out more economically than repair after neglect.

Most slope and hillside lot problems are associated with water. Uncontrolled water from a broken pipe, cesspool, or wet weather causes most damage. Wet weather is the largest cause of slope problems, particularly in California where rain is intermittent, but may be torrential. Therefore, drainage and erosion control are the most important aspects of home site stability; these provisions must not be altered without competent professional advice. Further, maintenance must be carried out to assure their continued operation.

As geotechnical engineers concerned with the problems of building sites in hillside developments, we offer the following list of recommended home protection measures as a guide to homeowners.

Expansive Soils

Some of the earth materials on site have been identified as being expansive in nature. As such, these materials are susceptible to volume changes with variations in their moisture content. These soils will swell upon the introduction of water and shrink upon drying. The forces associated with these volume changes can have significant negative impacts (in the form of differential movement) on foundations, walkways, patios, and other lot improvements. In recognition of this, the project developer has constructed homes on these lots on post-tensioned or mat slabs with pier and grade beam foundation systems, intended to help reduce the potential adverse effects of these expansive materials on the residential structures within the project. Such foundation systems are not intended to offset the forces (and associated movement) related to expansive soil, but are intended to help soften their effects on the structures constructed thereon.

Homeowners purchasing property and living in an area containing expansive soils must assume a certain degree of responsibility for homeowner improvements as well as for maintaining conditions around their home. Provisions should be incorporated into the design and construction of homeowner improvements to account for the expansive nature of the onsite soils material. Lot maintenance and landscaping should also be conducted in consideration of the expansive soil characteristics. Of primary importance is minimizing the moisture variation below all lot improvements. Such design, construction and homeowner maintenance provisions should include:

- Employing contractors for homeowner improvements who design and build in recognition of local building code and site specific soils conditions.
- Establishing and maintaining positive drainage away from all foundations, walkways, driveways, patios, and other hardscape improvements.

- Avoiding the construction of planters adjacent to structural improvements. Alternatively, planter sides/bottoms can be sealed with an impermeable membrane and drained away from the improvements via subdrains into approved disposal areas.
- Sealing and maintaining construction/control joints within concrete slabs and walkways to reduce the potential for moisture infiltration into the subgrade soils.
- Utilizing landscaping schemes with vegetation that requires minimal watering. Alternatively, watering should be done in a uniform manner as equally as possible on all sides of the foundation, keeping the soil "moist" but not allowing the soil to become saturated.
- Maintaining positive drainage away from structures and providing roof gutters on all structures with downspouts installed to carry roof runoff directly into area drains or discharged well away from the structures.
- Avoiding the placement of trees closer to the proposed structures than a distance of one-half the mature height of the tree.
- Observation of the soil conditions around the perimeter of the structure during extremely hot/dry or unusually wet weather conditions so that modifications can be made in irrigation programs to maintain relatively constant moisture conditions.

Sulfates

On site soils were tested for the presence of soluble sulfates. Based on the results of that testing, the soluble sulfate exposure level was determined to be “negligible” to “severe” when classified in accordance with the ACI 318-05 Table 4.3.1 (per 2010 CBC). Concrete mixes should be designed based on Code standards.

Homeowners should be cautioned against the import and use of certain fertilizers, soil amendments, and/or other soils from offsite sources in the absence of specific information relating to their chemical composition. Some fertilizers have been known to leach sulfate compounds into soils otherwise containing “negligible” sulfate concentrations and increase the sulfate concentrations in near-surface soils to “moderate” or “severe” levels. In some cases, concrete improvements constructed in soils containing high levels of soluble sulfates may be affected by deterioration and loss of strength.

Water - Natural and Man Induced

Water in concert with the reaction of various natural and man-made elements, can cause detrimental effects to your structure and surrounding property. Rain water and flowing water erodes and saturates the ground and changes the engineering characteristics of the underlying earth materials upon saturation. Excessive irrigation in concert with a rainy period is commonly associated with shallow slope failures and deep seated landslides, saturation of near structure soils, local ponding of water, and transportation of water soluble substances that are deleterious to building materials including concrete, steel, wood, and stucco.

Water interacting with the near surface and subsurface soils can initiate several other potentially detrimental phenomena other then slope stability issues. These may include expansion/contraction cycles, liquefaction potential increase, hydro-collapse of soils, ground surface settlement, earth material consolidation, and introduction of deleterious substances.

The homeowners should be made aware of the potential problems which may develop when drainage is altered through construction of retaining walls, swimming pools, paved walkways and patios. Ponded water, drainage over the slope face, leaking irrigation systems, over-watering or other conditions which could lead to ground saturation must be avoided.

- Before the rainy season arrives, check and clear roof drains, gutters and down spouts of all accumulated debris. Roof gutters are an important element in your arsenal against rain damage. If you do not have roof gutters and down spouts, you may elect to install them. Roofs, with their, wide, flat area can shed tremendous quantities of water. Without gutters or other adequate drainage, water falling from the eaves collects against foundation and basement walls.
- Make sure to clear surface and terrace drainage ditches, and check them frequently during the rainy season. This task is a community responsibility.
- Test all drainage ditches for functioning outlet drains. This should be tested with a hose and done before the rainy season. All blockages should be removed.
- Check all drains at top of slopes to be sure they are clear and that water will not overflow the slope itself, causing erosion.
- Keep subsurface drain openings (weep-holes) clear of debris and other material which could block them in a storm.
- Check for loose fill above and below your property if you live on a slope or terrace.
- Monitor hoses and sprinklers. During the rainy season, little, if any, irrigation is required. Oversaturation of the ground is unnecessary, increases watering costs, and can cause subsurface drainage.
- Watch for water backup of drains inside the house and toilets during the rainy season, as this may indicate drain or sewer blockage.
- Never block terrace drains and brow ditches on slopes or at the tops of cut or fill slopes. These are designed to carry away runoff to a place where it can be safely distributed.
- Maintain the ground surface upslope of lined ditches to ensure that surface water is collected in the ditch and is not permitted to be trapped behind or under the lining.
- Do not permit water to collect or pond on your home site. Water gathering here will tend to either seep into the ground (loosening or expanding fill or natural ground), or will overflow into the slope and begin erosion. Once erosion is started, it is difficult to control and severe damage may result rather quickly.
- Never connect roof drains, gutters, or down spouts to subsurface drains. Rather, arrange them so that water either flows off your property in a specially designed pipe or flows out into a paved driveway or street. The water then may be dissipated over a wide surface or, preferably, may be carried away in a paved gutter or storm drain. Subdrains are constructed to take care of ordinary subsurface water and cannot handle the overload from roofs during a heavy rain.

- ❖ Never permit water to spill over slopes, even where this may seem to be a good way to prevent ponding. This tends to cause erosion and, in the case of fill slopes, can eat away carefully designed and constructed sites.
- ❖ Do not cast loose soil or debris over slopes. Loose soil soaks up water more readily than compacted fill. It is not compacted to the same strength as the slope itself and will tend to slide when laden with water; this may even affect the soil beneath the loose soil. The sliding may clog terrace drains below or may cause additional damage in weakening the slope. If you live below a slope, try to be sure that loose fill is not dumped above your property.
- ❖ Never discharge water into subsurface blanket drains close to slopes. Trench drains are sometimes used to get rid of excess water when other means of disposing of water are not readily available. Overloading these drains saturates the ground and, if located close to slopes, may cause slope failure in their vicinity.
- ❖ Do not discharge surface water into septic tanks or leaching fields. Not only are septic tanks constructed for a different purpose, but they will tend, because of their construction, to naturally accumulate additional water from the ground during a heavy rain. Overloading them artificially during the rainy season is bad for the same reason as subsurface subdrains, and is doubly dangerous since their overflow can pose a serious health hazard. In many areas, the use of septic tanks should be discontinued as soon as sewers are made available.
- ❖ Practice responsible irrigation practices and do not over-irrigate slopes. Naturally, ground cover of ice plant and other vegetation will require some moisture during the hot summer months, but during the wet season, irrigation can cause ice plant and other heavy ground cover to pull loose. This not only destroys the cover, but also starts serious erosion. In some areas, ice plant and other heavy cover can cause surface sloughing when saturated due to the increase in weight and weakening of the near-surface soil. Planted slopes should be planned where possible to acquire sufficient moisture when it rains.
- ❖ Do not let water gather against foundations, retaining walls, and basement walls. These walls are built to withstand the ordinary moisture in the ground and are, where necessary, accompanied by subdrains to carry off the excess. If water is permitted to pond against them, it may seep through the wall, causing dampness and leakage inside the basement. Further, it may cause the foundation to swell up, or the water pressure could cause structural damage to walls.
- ❖ Do not try to compact soil behind walls or in trenches by flooding with water. Not only is flooding the least efficient way of compacting fine-grained soil, but it could damage the wall foundation or saturate the subsoil.
- ❖ Never leave a hose and sprinkler running on or near a slope, particularly during the rainy season. This will enhance ground saturation which may cause damage.
- ❖ Never block ditches which have been graded around your house or the lot pad. These shallow ditches have been put there for the purpose of quickly removing water toward the driveway, street or other positive outlet. By all means, do not let water become ponded above slopes by blocked ditches.

- Seeding and planting of the slopes should be planned to achieve, as rapidly as possible, a well-established and deep-rooted vegetal cover requiring minimal watering.
- It should be the responsibility of the landscape architect to provide such plants initially and of the residents to maintain such planting. Alteration of such a planting scheme is at the resident's risk.
- The resident is responsible for proper irrigation and for maintenance and repair of properly installed irrigation systems. Leaks should be fixed immediately. Residents must undertake a program to eliminate burrowing animals. This must be an ongoing program in order to promote slope stability. The burrowing animal control program should be conducted by a licensed exterminator and/or landscape professional with expertise in hill side maintenance.

Geotechnical Review

Due to the presence of expansive soils on site and the fact that soil types may vary with depth, it is recommended that plans for the construction of rear yard improvements (swimming pools, spas, barbecue pits, patios, etc.), be reviewed by a geotechnical engineer who is familiar with local conditions and the current standard of practice in the vicinity of your home.

In conclusion, your neighbor's slope, above or below your property, is as important to you as the slope that is within your property lines. For this reason, it is desirable to develop a cooperative attitude regarding hillside maintenance, and we recommend developing a "good neighbor" policy. Should conditions develop off your property, which are undesirable from indications given above, necessary action should be taken by you to insure that prompt remedial measures are taken. Landscaping of your property is important to enhance slope and foundation stability and to prevent erosion of the near surface soils. In addition, landscape improvements should provide for efficient drainage to a controlled discharge location downhill of residential improvements and soil slopes.

Additionally, recommendations contained in the Geotechnical Engineering Study report apply to all future residential site improvements, and we advise that you include consultation with a qualified professional in planning, design, and construction of any improvements. Such improvements include patios, swimming pools, decks, etc., as well as building structures and all changes in the site configuration requiring earth cut or fill construction.

PLATE 1

ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Suite B
Escondido, California 92029
Telephone: (714) 786-5661 Fax: (714) 409-3287

Project#	Report#	Date:
P/W 1612-03	1612-03-B-1	January 6, 2017

SOILS SOUTHWEST, INC.
SOILS, MATERIALS AND ENVIRONMENTAL ENGINEERING CONSULTANTS
897 VIA LATA, SUITE N • COLTON, CA 92324 • (909) 370-0474 • (909) 370-0481 • FAX (909) 370-3156

Report of
Soils and Foundation Evaluations
Proposed 30-lot Single Family Tract 32989
NEC Center Street and Mt Vernon Avenue
Highgrove area of Riverside County, California
APN: 255-150-01

Project No. 05156-F
July 15, 2005

Prepared for:

Paradigm Co., LLC
1795 Riverview Road
San Bernardino, California 92408

SOILS SOUTHWEST, INC.
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July 15, 2005

Project No. 05156-F

Paradigm Co., LLC
1795 Riverview Road
San Bernardino, California 92408

Attention: Ryan Cooke

Subject: Report of Soils and Foundation Evaluations
Proposed 30-lot Single Family Tract 32989
NEC Center Street and Mt Vernon Avenue
Highgrove area of Riverside County, California

Reference: Tentative Tract Plan prepared by Nolte Beyond Engineering

Gentlemen:

Presented herewith is the Report of Soils and Foundation Evaluations conducted for the site of the proposed 30-lot single family tract development for the Tract 32989, located near the northeast intersection of Center Street and Mt Vernon Avenue, within the Highgrove area of Riverside County, California.

The soils encountered primarily consist of upper dry, loose, slightly porous and compressible silty fine to medium coarse sand, followed by moderately dense, fine to medium coarse sand, overlying silty, fine to medium coarse sand. No shallow depth groundwater or bedrock was encountered. Potential for site soils liquefaction susceptibility is considered remote.

Based on field investigations and subsequent engineering evaluations, it is our opinion the site should be considered suitable for the planned development, provided the recommendations supplied are incorporated in final design and construction. For structural support, it is our opinion that conventional spread footings bearing exclusively into engineered fills of local soils should provide adequate support for the structures planned. Moderate site clearance and grading should be expected with the development proposed.

Thank you for the opportunity to be of service on this project. Please call the undersigned should you have any questions regarding this report.

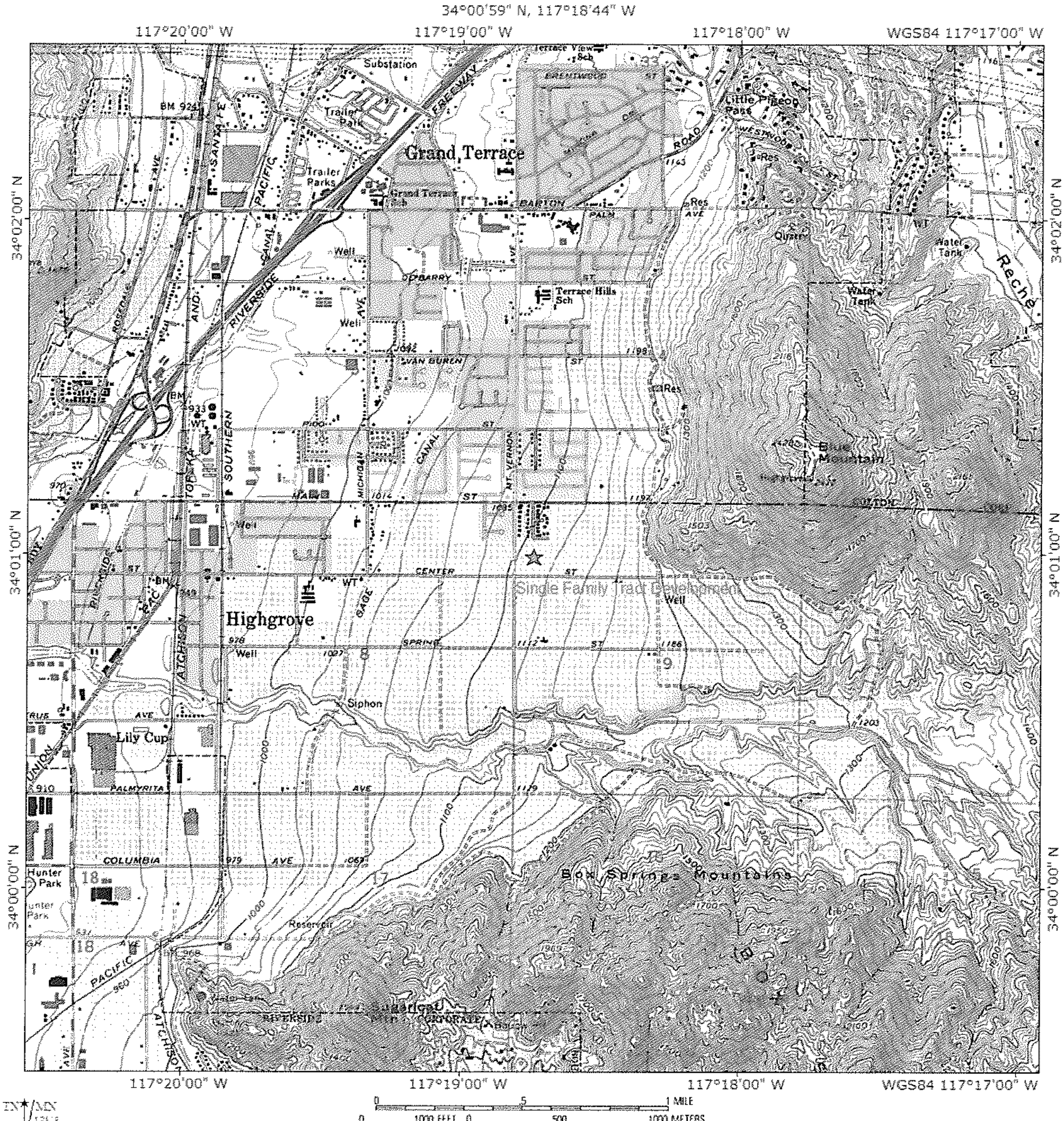
Respectfully submitted,
Soils Southwest, Inc.

REGISTERED PROFESSIONAL ENGINEER
MOLOY K. GUPTA
No. 31708
Exp. 12-31-06
CIVIL
STATE OF CALIFORNIA

Moloy Gupta, RCE 31708

Roy White

Dist/5-addressee



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Soils Southwest, Inc.

Site Index Map

PROPOSED RESIDENTIAL
NEC CENTER ST & MT VERNON
RIVERSIDE COUNTY, CA

FIGURE: 1
PN: 05156-F
DATE: JULY 2005

1.0 Introduction

This report presents the results of Soils and Foundation Evaluations conducted for the site of the proposed 30-lot single family tract development for the Tract 32989, located near the northeast intersection of Center Street and Mt Vernon Avenue, within Highgrove area of Riverside County, California. No site-specific geologic evaluation is made and none such is requested by the addressee. A report of site geologic study will be supplied, if and when requested.

The purpose of this evaluation is to determine the nature and engineering properties of the near grade and subsurface soils, and to provide geotechnical recommendations for foundation design, slab-on-grade, retaining wall, paving, parking, site grading, utility trench backfill and inspection during construction.

The recommendations contained reflect our best estimate of the soils conditions encountered during field investigations conducted for the site. It is not to be considered as a warranty of the soils for other areas, or for the depths beyond the explorations advanced at this time.

The recommendations supplied should be considered valid and applicable when the following conditions, are fulfilled:

i. Pre-grade meeting with contractor, public agency and soils engineer,
ii. Excavated bottom inspections and verifications by soils engineer prior to backfill placement,
iii. Continuous observations and testing during site preparation and structural fill soils placement,
iv. Observation and inspection of footing trenching prior to steel and concrete placement,
v. Plumbing trench backfill placement prior to concrete slab-on-grade placement,
vi. On and off-site utility trench backfill testing and verifications, and
vii. Consultations as required during construction, or upon your request

IN ABSENCE OF PRECISE GRADING PLAN, THE GEOTECHNICAL RECOMMENDATIONS SUPPLIED SHOULD BE CONSIDERED AS 'PRELIMINARY'. SUPPLEMENTAL RECOMMENDATIONS MAY BE WARRANTED FOLLOWING GRADING PLAN REVIEW.

1.1 Proposed Development

Based on the tentative tract plan supplied, it is understood that the subject development will include thirty (30) lots single family dwellings of one and two-story structures. Conventional wood-frame and stucco construction with spread footings are expected. Associated construction of minor retaining walls, interior streets, curb-gutter and off-site street improvements are anticipated to complete the project. Moderate site preparations and grading are anticipated with the development planned. Import soils are expected for finish pad grades.

1.2 Site Description

The near level parcel of about 10 acres is currently vacant and undeveloped. In general, the site is bounded on the north by residential property, on the south by Center Street, on the east by a residential tract development, and on the west by Mt Vernon Avenue. Overall vertical relief within the parcel is estimated to about 24 feet, with sheetflow from incidental rainfall flowing towards northwest. With the exception of seasonal weeds, no other significant features pertinent to the planned development were noted.

2.0 Scope of Work

Being beyond scope of work, no Geologic and/or Environmental Site Assessment is included. Reports on such will be provided on request.

Geotechnical evaluation for the project included subsurface explorations, soil sampling, necessary laboratory testing, engineering analyses and the preparation of this report. The scope of work included the following tasks:

o **Field Testing**

Four (4) exploratory test borings using a Hollow-Stem Auger (HSA) drill-rig equipped for undisturbed soils sampling and Standard Penetration Testing (SPT). The exploratory depth was advanced to maximum 30 feet below the current grade surface. Approximate test excavation location is shown on Plate 1.

During exploration, the soils encountered during explorations were continuously logged, and bulk and undisturbed samples were procured. Collected samples were subsequently transferred to our laboratory for necessary testing. Description of the soils encountered is shown on the Test Exploration Logs in Appendix A.

o **Laboratory Testing**

Representative samples on selected bulk and undisturbed site soils were tested in the laboratory to aid in the soils classification and to evaluate relevant engineering properties of the existing site soils pertaining to the project requirements. These tests may include some or all of the following tests depending upon site requirements:

- In-situ moisture contents and dry density (ASTM Standard D2216-80)
- Gradation analysis (ASTM Standard D422-63)
- Maximum dry density and optimum moisture content (ASTM Standard D1557-91)
- Sand equivalent (ASTM Standard D2419-95)
- Direct Shear (ASTM Standard D3080-90)
- Collapse potential (ASTM D5333-92)
- Expansion index (ASTM Standard D4829-88)

Brief descriptions of the test procedures used and the test results are provided in Appendix B.

o Based on the data of our field investigations and laboratory testing, engineering analyses and evaluations were made, on which to base our recommendations for foundation design, slab-on-grade, site preparations and grading and inspection during construction.

3.0 Existing Site Conditions

3.1 Subsurface Conditions

In general, the consist of upper dry, loose, slightly porous and compressible silty fine to medium coarse sand, followed by moderately dense, fine to medium coarse sand, overlying silty, fine to medium coarse sand. No shallow-depth groundwater and/or bedrock were encountered.

Based on exploratory borings, soil sampling, laboratory testing and engineering evaluations, it is our opinion that the upper dry alluviums described are compressible and variable in consistency in nature, and thus should be considered unsuitable for directly supporting new structural fills and/or load bearing foundations without excessive differential settlements. For adequate support, it is our opinion that the upper dry and low-density silty sandy alluviums should be subexcavated so as to expose the underlying moist and dense gravelly fine sand, followed by the excavated soil replacement as engineered fills compacted to minimum 90%. The general recommendations for site preparations and grading are described in Section 4.1.1 of this report.

Laboratory shear tests conducted on the upper bulk soil sample remolded to 90 percent exhibit moderate shear strengths under increased moisture conditions. Results of the laboratory shear tests are provided in Plate B-1 of this report.

Consolidation tests conducted on the upper bulk soils remolded to 90% and on the undisturbed samples procured at a depth, indicate low potential for compressibility under expected structural loading. The results of soils consolidation tests are shown on Plate B-2.

Sandy in nature, the site soils are considered non-critically expansive in characteristics, thereby requiring no special geotechnical reinforcements other than those as described in this report.

It is recommended that following mass-grading completion, lot-by-lot soil expansion potential should be verified based on which revised recommendations on footings and slab-on-grade may be warranted.

3.2 Excavatibility

It is our opinion that grading and excavations required for the project may be accomplished using conventional heavy-duty construction equipment. No blasting or jack-hammering is anticipated. However, heavy caving may be experienced during deep trenching and during cut slope preparations.

3.3 Groundwater

No groundwater was encountered within the maximum depth explored and none such is anticipated within 100 feet below the present grade surface. No special construction requirements should be expected, however, it is suggested that provisions should be made so as to dispose off surface runoff away from the structural pads once constructed.

3.4 Subsurface Variations

Based on the results of subsurface explorations and local experience from similar projects completed as of this date, it is our opinion that variations in subsoils continuity, depths of subsoils deposit and ground water conditions, may be expected. Due to the nature and depositional characteristics of the soils underlying, care should be exercised in interpolating and/or extrapolating of the subsurface conditions existing in between and beyond the test explorations described. Although not encountered, underlying buried utilities may be expected during grading and construction.

3.5 Liquefaction

Liquefaction is caused by build up of excess hydrostatic pressure in saturated cohesionless soils due to cyclic stress generated by ground shaking during an earthquake. The significant factors on which liquefaction potential of a soil deposit depends, among others include, soil type, relative density, intensity of earthquake, duration of ground shaking, and depth of ground water.

With the historical groundwater table at a depth in excess of 50 feet, along with the presence of underlying gravelly sandy soils with numerous rocks, it is our opinion that site soil liquefaction potential susceptibility should be considered remote.

3.6 Seismic Design Parameters as Per 2001 CBC

The site is located within Southern California, which is within an active seismic area where large numbers of earthquakes are recorded each year. Based on CDMG Special Report 113, no earthquake faults are apparently traversing the property under study.

However, the site is located at about 18.8 km from A-Fault (San Andreas-Southern) and at about 4.2 km from B-Fault (San Jacinto-San Bernardino Fault). Accordingly, for foundation and structural design, the following seismic parameters are suggested based on the current CBC/UBC:

Recommended values are based upon Thomas F. Blake UBCSEIS seismic software which is found in the supplemental seismic parameters provided in Appendix C of this report.

CBC/UBC Chapter 16 Table No.	Seismic Design Parameters	Recommended Value
16-I	Seismic Zone Factor, Z	0.4
16-J	Soil Profile Type	S_d
16-Q	Seismic Coefficient, C_a	$0.44N_a$
16-R	Seismic Coefficient, C_v	$0.64N_v$
16-S	Near Source Factor, N_a	1.1
16-T	Near Source Factor, N_v	1.3
16-U	Seismic Source Type	M=6.7

4.0 Evaluations and Recommendations

4.1 General Evaluations

Based on field explorations, laboratory testing and engineering analysis completed at this time, the following conclusions and recommendations are presented for the site under study:

(i) From geotechnical viewpoint, the site is considered grossly stable and suitable for the proposed development, provided the recommendations supplied are implemented during grading and construction.

(ii) With the presence of the upper dry, loose, slightly porous, hydro-collapsible and compressible silty sandy alluviums as described, it is our opinion that no load bearing foundations, paving, concrete flatwork or new load bearing structural fills should be should be placed bearing directly on the near surface alluviums existing. For adequate support with tolerable settlements to structural elements and/or to new structural fills, it is our opinion that site preparations should be considered including subexcavations of the upper dry, loose, slightly porous, hydro-collapsible and compressible alluviums, followed by the excavated soil replacement as engineered fills compacted to minimum 90%. No new fill soils should be placed bearing directly on the grade surface existing.

(iii) It is recommended that structural footings should be established exclusively into engineered fills of local gravelly sandy soils compacted to minimum 90%. Construction of footings and slabs straddling over cut/fill transition shall not be allowed.

(iv) Structural design consideration should include probability for moderate to high peak ground acceleration from relatively active nearby earthquake faults. The adverse effects of ground shaking, however, can be minimized by implementing the seismic design parameters and procedures as outlined in the current CBC/UBC and as described earlier in Section 3.6 of this report.

(v) Although no groundwater was encountered, provisions should be maintained during construction to divert incidental rainfall away from the structural pads constructed.

(vi) Design recommendations are based upon the use of non-expansive type soils. In event clay soils are encountered or clay type import fill soils are used, further testing and recommendations are required.

4.1.1 Preparations for Structural Pads

In absence of site specific grading and/or development plans no finish pad grade elevations are known at this time. Consequently, the following tentative grading recommendations are provided for preliminary use. Upgraded and/or revised recommendations will be supplied when grading plans are made available to us for review. As per the Riverside County Grading ordinance, the site preparations and grading described should encompass the entire individual pad areas, from property line to property line.

No cut-fill transition conditions should be associated with the structural pads proposed. In general, with the presence of the near grade dry, loose, slightly porous, hydro-collapsible and compressible silty sandy soils existing, it is recommended that no new structural fills and/or load bearing footings should be placed bearing directly on the surface soils existing. For adequate support, it is our opinion that, irrespective of the fill soil placement depths proposed to the planned pads, prior to such fill soil placement, the existing near surface compressible alluviums should be subexcavated; moisture conditioned, reworked and recompacted as described herein. The subexcavation depths should be at least 4.5 to 5 feet below the present grade surface, or to the depth as verified by soils engineer during grading. No fill soil placement should be allowed without the subgrade preparations described.

Deeper subexcavations may be expected within the areas of abandoned septic systems, old tree stumps or other abandoned buried footings or subsurface structures. Local soils free of organic and debris may be considered suitable for using as structural backfill.

The following general grading procedures are recommended for the structural pads proposed:

A. For the portions of the **pads planned at near existing grade surface**, site preparations and mass grading should include removals of the near surface dry, loose, porous, hydro-collapsible and compressible alluviums to about 4.5 to 5 feet or more, followed by moisturization and recompaction of the surface exposed prior to the excavated soil replacement as engineered fills compacted to minimum 90%. The subexcavation depth described should be considered 'approximate'. Actual subexcavation depth should be determined by soils engineer during grading.

B. Within the areas of the planned **pads requiring new structural fill soils** placement to proposed finish grade, prior to such fill soil placement, site preparations should include subexcavations of the upper dry alluvium to about 4.5 to 5 feet, or to the depth as required to expose the underlying moist and dense subgrades, followed by recompaction and the excavated and import soils placement to proposed finish pad grade compacted to minimum 90%. The subexcavated bottoms should be verified and approved by soils engineer prior to the structural fill soil placement.

C. For finish grades for the **pads requiring minor 'cuts'** to the present grades, site preparations, following such cuts, should include further subexcavations to the depth as required to expose the underlying moist and dense gravelly sandy soils, or to the sufficient depth as required to maintain a minimum 30-inch thick compacted fill mat blanket below the proposed finish grade surface, or to the depth as required to maintain a 24-inch thick compacted fill mat below footing bottoms, whichever is greater. The subexcavation depths should be verified prior to the structural fill placement described.

D. Within **areas of cut/fill transition**, it is recommended that following the required cuts to proposed grade surface, the subgrades exposed should be further subexcavated to sufficient depth so as to maintain an overall minimum 24-inch thick compacted fill mat blanket below footing bottoms as described earlier. Within the areas requiring new fill soil placement to finish grades, site preparation should include subexcavations of the upper existing dry and loose soils to minimum 4.5 to 5 feet, followed by moisturization, scarification and recompaction prior to new engineered fill soils placement.

The subexcavation depths described should be considered 'approximate'. Actual depths should be dictated by soils engineer during grading. The site grading procedures described should, in minimum, encompass the planned building footprint areas and five feet beyond. In the event new fill (import) soils are required, such should be placed following the subgrade preparations as described. Unless otherwise stated in this report, all structural fill soils should be placed compacted to minimum 90% Use of vibratory sheep's-foot roller may be considered during mass grading.

The surface exposed following subexcavations should be further scarified to 6-inch, moisture conditioned to 3% to 5% over Optimum, and recompacted prior to the local excavated soil replacement as structural fill compacted to minimum 90%. Localized additional subexcavations may be required following removal of buried utilities, if any. The subexcavation depth described should be considered 'preliminary'. Actual subexcavation depth should be determined by soils engineer during grading.

4.1.2 Structural Fill Material Requirements

(i) Non-expansive in nature, the on-site soils free of organic, debris and rocks larger than 6-inch in diameter, should be considered suitable for re-use as structural backfill. In event clay soils are encountered or clay type import fill soils are used, further testing and recommendations are required.

(ii) Representative site soils sampled from graded fills expected in contact with footings and utilities should be laboratory tested to verify presence of Sulfate, pH and Resistivity. Based soil chemical test results, supplemental design parameters may be warranted.

4.2 Spread Foundations

The structures planned may be supported by continuous wall and/or isolated spread footings founded exclusively into engineered fill compacted to minimum 90%.

Footings placed should be sized accordingly:

Perimeter Footings:	Interior Footings:
Single Story: 12"x12"	Single Story: 12"x12"
Two Story: 15"x18"	Two Story: 12"x12"

Structural design should conform to the current CBC/UBC Seismic Design requirements as described in Section 3.6 of this report.

In order to minimize potential differential settlements, use of footings straddling over cut/fill transition, shall be avoided. It is recommended that the excavated footing trenches should be sufficiently 'dampened' to about 3 to 5% over Optimum Moisture Content immediately prior to concrete placement. No large rocks and cobbles greater than 8-inch in diameter should be placed directly underneath structural footings during grading.

For design, an allowable soil vertical bearing capacity of 1800 psf may be considered. If normal code requirements are applied, the above capacities may further be increased by an additional 1/3 for short duration of loading which includes the effect of wind and seismic forces.

From geotechnical view point, footing reinforcements consisting of 2-#4 rebar placed near the top and 2-#4 rebar placed near the bottom of continuous footings are recommended. Additional reinforcements may be required.

Settlements of properly designed and constructed foundations supported on engineered fill, comprising of site soils or its equivalent or better, and carrying maximum anticipated vertical loadings, are expected to be within tolerable limits. Estimated total and differential settlements are about 1 and 3/4-inch, respectively. However, with the presence of the gravelly sandy local soils, most of the elastic deformations are expected during construction.

It should be noted that following mass grading completion, in the event finished grade soils exhibit soil Expansion Index, EI, greater than 20, revised foundation recommendations will be required.

4.3 Concrete Slab-on-Grade

No concrete slabs, curb-gutter, sidewalks and flatworks should be placed bearing directly on the surface soils existing. The prepared subgrades to receive footings should be adequate for concrete slab-on-grade placement. For normal load bearing conditions, 4-inch thick (nominal) concrete slabs reinforced with 6x6-#10x#10 WWF, or with #3 rebar at 24-inch o/c, may be considered. For driveways, concrete slabs should be 3.5-inch (net) thick, placed over local gravelly soils compacted to at least 90%. Driveway slab reinforcing and construction and expansion joints etc. should be incorporated if required by the project structural engineer.

Within moisture sensitive areas, concrete slabs should be underlain by 2-inch of compacted clean sand, followed by 6-mil thick Visqueen. The gravelly sands used should have a Sand Equivalent, SE, of 30 or greater.

Subgrades to receive concrete should be 'dampened' as would be expected in any such concrete placement. Use of low-slump concrete is recommended. In addition, it is recommended that utility trenches underlying concrete slabs and driveways should be thoroughly backfilled with gravelly sandy soils mechanically compacted to minimum 90% immediately prior to concrete pour.

4.4 Resistance to Lateral Loads

Resistance to lateral loads can be restrained by friction acting at the base of foundation and by passive earth pressure. A coefficient of friction of 0.35 may be assumed with normal dead load forces for footing established on compacted fill.

An allowable passive lateral earth resistance of 230 pounds per square foot per foot of depth may be assumed for the sides of foundations poured against compacted fill. The maximum lateral passive earth pressure is recommended not to exceed 2300 pounds per square foot.

4.5 Shrinkage and Subsidence

It is our opinion that during grading the upper soils may be subjected to a volume change. Assuming a 90% relative compaction for structural fills and assuming an overexcavation and re-compaction depth of 48 inches, such volume change due to shrinkage may be on the order of 18 to 20 percent. Additional shrinkage may be expected within the low-lying areas of natural drainage swales. Supplemental volume change may be expected due to shrinkage during preparation of subgrade soils. For estimation purpose, such may be approximated to about 3-inch or more.

4.6 Construction Considerations

4.6.1 Unsupported Excavation

Site soils are highly susceptible to caving. Temporary excavations up to 5 feet in depth may be made without rigorous lateral supports. Excavated surface should be 'dampened' during construction in order to minimize potential surface soil raveling. No surcharge loading should be allowed within an imaginary 1:1 line drawn upward from toe of temporary excavations.

4.6.2 Supported Excavations

If vertical excavations exceeding 5 feet in depths become warranted, such should be achieved using shoring to support side walls.

4.7 Cut and fill Slopes

Unless otherwise described earlier, it is our opinion that cut and fill slopes planned should be constructed at a slope ratio not exceeding 2 to 1 (horizontal to vertical). Adequate slope covering should be incorporated in form of draught resistant deep rooted vegetation approved by the local public agency. In addition, the yards adjacent to slopes should be graded in such so that no surface water is directed overflowing the slope constructed.

4.8 Site Preparations

With the dry, loose and compressible nature of the near surface alluviums described, site preparations should, in minimum, consist of the subexcavations and replacement of the local soils as described earlier. Earth works described should be in accordance with the applicable grading recommendations as provided in the current CBC/UBC and as recommended in Section 5.0 of this report.

4.9 Soil Caving

Dry and gravelly in nature, the site soils are considered 'highly' susceptible to caving. Temporary excavations in excess of 5 feet should be made at a slope 2 to 1 (h:v), or flatter, and as per the construction guidelines as provided by the Cal-Osha.

4.10 Structural Pavement Thickness

Flexible Asphalt Paving: Based on estimated Traffic Index (TI) and on soil R-value of 50, the following tentative paving sections are supplied for estimation purposes. It is suggested that following mass grading completion, the paving sections supplied should be further verified based on actual soil R-value analysis conducted on the samples procured from street finish grades.

Service Area	Traffic Index, TI	Paving Type	Paving Thickness, in.
Exterior Street Widening	6.5	a.c over base	3.5" a.c over 6" base
Interior Street	5.5	a.c over base	3" a.c over 4.5" base

For a.c over base, the upper 12-inch subgrade soils should be subexcavated, scarified and compacted to minimum 90%. Base materials used should be compacted to minimum 95%. Final pavement sections should be verified and approved by the local public agency prior to their use.

4.10 Retaining Wall

Earth retaining walls, if required, should be designed based on following parameters:

Slope of Retained Material (H:V)	Equivalent Fluid Density, pcf	
	Clean Sand	Local Soil
level	30	37
2:1	42	63

Walls adjacent to traffic areas should be designed to resist a uniform lateral pressure of 100 pounds per square foot, which is a result of an assumed 300 pounds per square foot surcharge behind the walls due to normal traffic. If the traffic is kept back ten feet from the wall, the traffic surcharge may be neglected.

The design parameters do not include any hydrostatic pressure build-up. Consequently, installation of 'french-drain' behind retaining walls is recommended to minimize water pressure build-up behind retaining walls. Use of impervious material is preferred within upper the 18 inches of the backfill placed.

Backfills behind retaining wall should be compacted to a minimum 90 percent relative laboratory Maximum Dry Density as determined by the ASTM D1557-91 test method. Flooding and/or jetting behind wall should not be permitted. Local sandy soils may be used as backfill.

4.11 Utility Trench Backfill

Utility trench backfill within the structural pad and beyond, should be placed in accordance with the following recommendations:

- Trench backfill should be placed in 6 to 8-inch thin lifts mechanically compacted to 90 percent or better of the laboratory maximum dry density for the soils used. Jetting is not recommended within utility trench backfill. Within streets, upper 1.5 feet of the trench backfill should be compacted to 95%, or better.

- Exterior trenches along a foundation or a toe of a slope and extending below a 1:1 imaginary line projected from the outside bottom edge of the footing or toe of the slope should be compacted to 90 percent of the Maximum Dry Density for the soils used during backfill. All trench excavations should conform to the requirements and safety as specified by the Cal-Osha

4.12 Pre-Construction Meeting

It is recommended that no clearing of the site or any grading operation be performed without the presence of a representative of this office. An on-site pre-grading meeting should be arranged between the soils engineer and the grading contractor prior to any construction.

4.13 Seasonal Limitations

No fill shall be placed, spread or rolled during unfavorable weather conditions. Where the work is interrupted by heavy rains, fill operations shall not be resumed until moisture conditions are considered favorable by the soils engineer.

4.14 Planters

In order to minimize potential differential settlement to foundations, use of planters requiring heavy irrigation should be restricted from using adjacent to footings. In event such becomes unavoidable, planter boxes with sealed bottoms, should be considered.

4.15 Landscape Maintenance

Only the amount of irrigation necessary to sustain plant life should be provided. Pad drainage should be directed towards streets and to other approved areas away from foundations. Slope areas should be planted with draught resistant vegetation. Over watering landscape areas could adversely affect the proposed site development during its life-time use.

4.16 Observations and Testing During Construction

Recommendations provided are based on the assumption that structural footings and slab-on-grade be established exclusively into compacted fills. Excavated footings should be inspected, verified and certified by soils engineer prior to steel and concrete placement. Structural backfills discussed should be placed under direct observations and testing by this facility. Excess soils generated from footing trench excavations should be removed from pad areas and such should not be allowed on concrete slab-subgrades.

4.17 Plan Review

Precise grading plans, when prepared, should be available for review to ensure applicability of the assumptions made in preparing this report. If during construction, conditions are observed different from those as presented, revised and/or supplemental recommendations will be required.

5.0 Earth Work/General Grading Recommendations

Site preparations and grading should involve overexcavation and replacement of local soils as structural fill compacted to the minimum relative compactions as described earlier.

Structural Backfill:

Local soils free of debris, large rocks and organic should be considered suitable for reuse as backfill. Loose soils, formwork and debris should be removed prior to backfilling retaining walls. On-site sand backfill should be placed and compacted in accordance with the recommended specifications provided below. Where space limitations do not allow conventional backfilling operations, special backfill materials and procedures may be required. Pea gravel or other select backfill can be used in limited space areas. Recommendations for placement and densification of pea gravel or other special backfill can be provided during construction.

Site Drainage:

Adequate positive drainage should be provided away from the structure to prevent water from ponding and to reduce percolation of water into backfill. A desirable slope for surface drainage is 2 percent in landscape areas and 1 percent in paved areas. Planters and landscaped areas adjacent to building perimeter should be designed to minimize water filtration into subsoils. Considerations should be given to the use of closed planter bottoms, concrete slabs and perimeter subdrains where applicable.

Utility Trenches:

Buried utility conduits should be bedded and backfilled around the conduit in accordance with the project specifications. Where conduit underlies concrete slab-on-grade and pavement, the remaining trench backfill above the pipes should be placed and compacted in accordance with the following grading specifications.

General Grading Recommendations:

Recommended general specifications for surface preparation to receive fill and compaction for structural and utility trench backfill and others are presented below.

1. Areas to be graded, backfilled or paved, shall be grubbed, stripped and cleaned of all buried and undetected debris, structures, concrete, vegetation and other deleterious materials prior to grading.

2. Where compacted fill is to provide vertical support for foundations, all loose, soft and other incompetent soils should be removed to full depth as approved by soils engineer, or at least up to the depth as previously described in this report. The areas of such removal should extend at least 5 feet beyond the perimeter of exterior foundation limit or to the extent as approved by soils engineer during grading.

3. The fills to support foundations and slab-on-grade should be compacted to minimum 90% of the soil's Maximum Dry Density at 3 to 5% over Optimum. In order to minimize potential differential settlements to foundations and slabs straddling over cut and fill transition, cut portions following cut, should be further over-excavated and such be replaced as engineered fill compacted to at least 90% of the soil's Maximum Dry Density as described in this report.

4. Utility trenches within building pad areas and beyond should be backfilled with granular material and such should be mechanically compacted to at least 90% of the maximum density for the material used.

5. Compaction for structural fills shall be determined relative to the maximum dry density as determined by ASTM D1557-91 compaction methods. All in-situ field density of compacted fill shall be determined by the ASTM D1556-82 standard methods or by other approved procedures.

6. All new imported soils, if required, shall be clean, granular, non-expansive material or as approved by the soils engineer.

7. During grading, fill soils shall be placed as thin layers, thickness of which following compaction shall not exceed six to eight inches.

8. No rocks over six to eight inches in diameter shall be permitted to use as a grading material without prior approval of the soils engineer.

9. No jetting and/or water tampering be considered for backfill compaction for utility trenches without prior approval of the soils engineer. For such backfill, hand tampering with fill layers of 8 to 12 inches in thickness, or as approved by the soils engineer is recommended.

10. Utility trenches at depth and cesspool and abandoned septic tank existing within building pad areas and beyond, should be excavated and removed, or such should be backfilled with gravel, slurry or by other material as approved by soils engineer.

11. Imported fill soils if required, should be equivalent to site soils or better. Such should be approved by the soils engineer prior to their use.

12. Grading required for pavement, side-walk or other facilities to be used by general public, should be constructed under direct observation of soils engineer or as required by the local public agencies.

13. A site meeting should be held between grading contractor and soils engineer prior to actual construction. Two days of prior notice will be required for such meeting.

6.0 Closure

In absence of site-specific grading plans, the recommendations supplied should be considered 'preliminary', and may require substantial revision and/or modifications prior to actual grading and construction.

From geotechnical viewpoint, the conclusions and recommendations presented are based upon the findings and observations as made during subsurface test borings. If during construction, the subsoil conditions appear different from those as disclosed during field investigation this office should be notified to consider any possible need for modification for the geotechnical recommendations as provided in this report.

Recommendations provided are based on the assumptions that structural footings will be established exclusively into compacted fill. No footings and/or slabs be allowed straddling over cut/fill transition interface.

Site grading must be performed under observations by a geotechnical representative of this office. Further, it is recommended that excavated footings and concrete slab subgrades should be verified and approved by soils engineer prior to steel and concrete placement to ensure that foundations are founded into satisfactory soils and the slab subgrades are compacted and unyielding.

A pregrading meeting between grading contractor and soils engineer is recommended prior to construction preferably at the site, to discuss the grading procedures to be implemented and other requirements described in this report to be fulfilled.

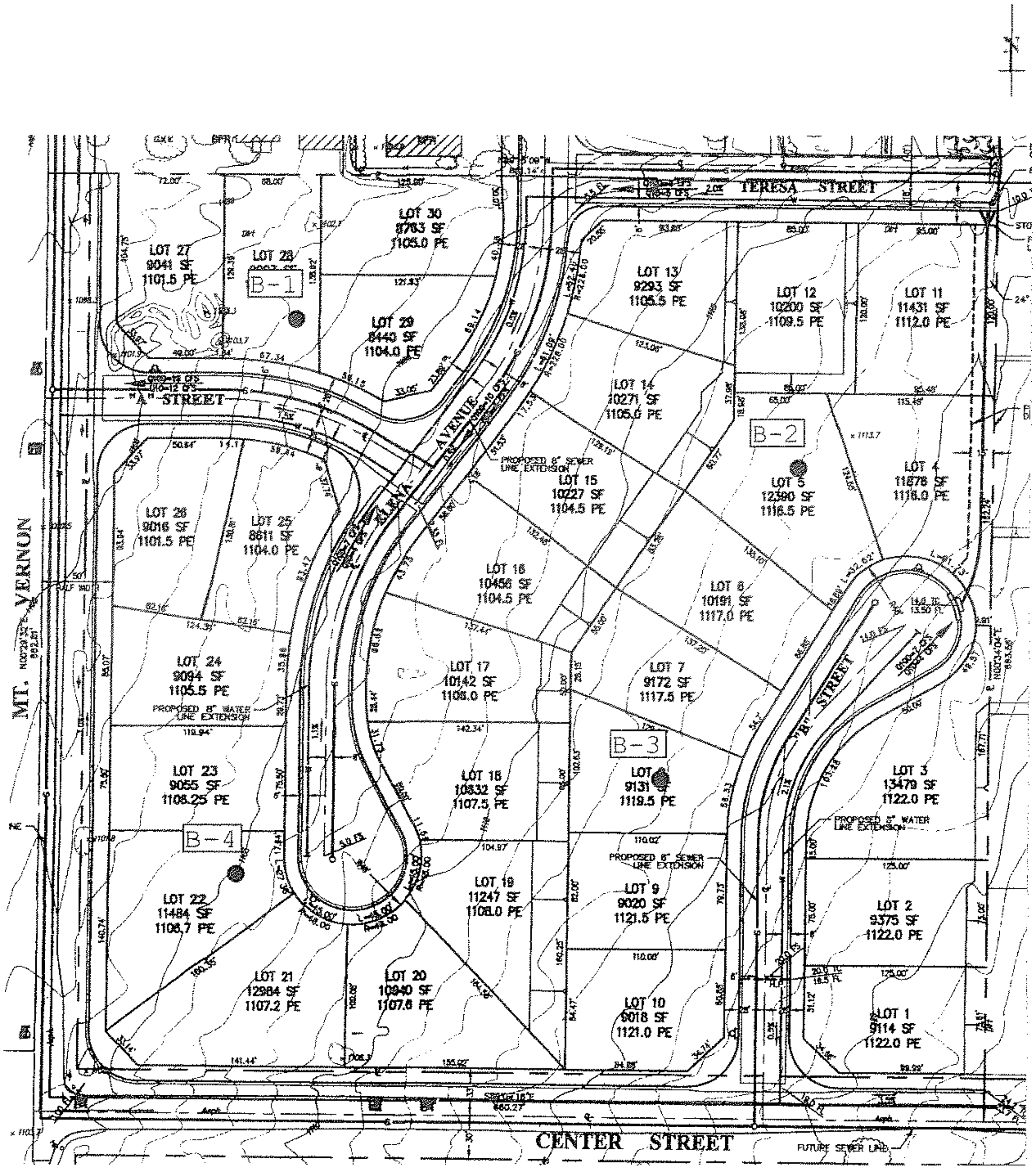
This report has been prepared exclusively for the use of the addressee for the project referenced in the context. It shall not be transferred or be used by other parties without a written consent by Soils Southwest, Inc. We cannot be responsible for use of this report by others without inspection and testing of grading operations by our personnel.

Should the project be delayed beyond one year after the date of this report; the recommendations presented shall be reviewed to consider any possible change in site conditions.

The recommendations presented are based on the assumption that the necessary geotechnical observations and testing during construction will be performed by a representative of this office. The field observations are considered a continuation of the geotechnical investigation performed.

If another firm is retained for geotechnical observations and testing, our professional liability and responsibility shall be limited to the extent that Soils Southwest, Inc. would not be the geotechnical engineer of record. Further, use of the geotechnical recommendations by others will relieve Soils Southwest, Inc. of any liability that may arise during lifetime use of the structures constructed.

PLOT PLAN AND TEST LOCATIONS
(Schematic, not to scale)



Legend: ● B-1 Approximate Location of Test Exploration Plate 1

7.0 APPENDIX A

Field Explorations

Field evaluations included site reconnaissance and exploratory test borings using a Hollow-Stem Auger (HSA) drill-rig equipped for soil sampling and Standard Penetration Test (SPT). During site reconnaissance, the surface conditions were noted and test excavation locations were determined. Approximate test boring locations are shown on Plate 1.

Soils encountered during explorations were logged and such were classified by visual observations in accordance with the generally accepted classification system. The field descriptions were modified, where appropriate, to reflect laboratory test results.

Where feasible, relatively undisturbed soils were sampled using a drive sampler lined with soil sampling rings. The split barrel steel sampler was driven into the bottom of test excavations at various depths. Soil samples were retained in brass rings of 2.5 inches in diameter and 1.00 inch in height. The central portion of each sample was enclosed in a close-fitting waterproof container for shipment to our laboratory. In addition to 'undisturbed' soil sampling, bulk soils were and such were used in supplemental testing as described in the boring logs.

Logs of test explorations are presented in the following summary sheets that include the description of the soils and/or fill materials encountered.

LOG OF TEST EXPLORATIONS

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-1

Project: Victoria Homes / Tr.32989		Job No.:	05156-F
Logged By: John	Boring Diam.: 8"	Date:	29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
								Weeds
	Bulk/Grab				SP-SM		0	Sand - Lt brn, silty, dry, fine to med., pebbles, slighlty porous (Max 133 pcf @ 9.0%)
	California	4.0	107	80			3	
7	Standard penetration						5	
					SP		5	- Lt brn, slightly silty, fine to med. coarse, pebbles, rock frag., slightly porous
	California	4.5	120	90			8	
20	Standard penetration						10	- Lt brn, slightly silty, fine to med., pebbles

Depth in Feet scale: 2, 4, 6, 8, 10, 12

Groundwater: None
Approx. Depth of Bedrock: None
Datum: N/A
Elevation: N/A

Site Location
NEC Center & Mt Vernon
Riverside County

Plate #

Bulk/Grab sample | California sampler | Standard penetration test

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-1

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
							14	
25								
							16	
							18	
							20	
27								- Yellow brn, fine to med. coarse, rock frag.
							22	
							24	
23								
							26	
							28	
								- Lt brn, fine to med. coarse, pebbles,

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-1

Project: Victoria Homes / Tr.32989	Job No.: 05156-F
Logged By: John · Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
								rock frag.
							30	
24								
								- End of boring @ 31' No bedrock No groundwater
							32	
							34	
							36	
							38	
							40	
							42	
							44	

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-2

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
					SP		0	Weeds
								Sand - Brn, dry, fine to med., pebbles, slighlty porous, slightly silty
							2	
10	Standard penetration test							
							4	
	California sampler	8.0	117	88				
							6	
							8	
27	Standard penetration test							
							10	
							12	
								- Lt brn, fine to med. coarse, pebbles, rock frag.
12	Standard penetration test							

	Site Location	Plate #
Groundwater: None Approx. Depth of Bedrock: None Datum: N/A Elevation: N/A	NEC Center & Mt Vernon Riverside County	

Bulk/Grab sample California sampler Standard penetration test

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-2

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
							14	
							16	- Lt brn, med. to coarse
							18	
25					SP-SM			- Lt brn, silty, fine to med., pebbles
							20	- End of boring @ 20' No bedrock No groundwater
							22	
							24	
							26	
							28	

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-3

Project: Victoria Homes / Tr.32989		**Job No.:** 05156-F	
Logged By: John	**Boring Diam.:** 8"	**Date:** 29 Jun 05	

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
					SP			Weeds
								Sand - Brn, slightly silty, dry, fine to med., pebbles, slightly porous
							2	
							4	
18	Standard penetration test							
							6	
							8	
16	Standard penetration test							- Scattered rock 1", moist
							10	
							12	

Groundwater: None
Approx. Depth of Bedrock: None
Datum: N/A
Elevation: N/A

Site Location
NEC Center & Mt Vernon
Riverside County

Plate #

Bulk/Grab sample   California sampler   Standard penetration test

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-3

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
							14	
					SP-SM			- Lt brn, silty, moist, fine to med., coarse, pebbles, rock frag.
27							16	
								- End of boring @ 16' No bedrock No groundwater
							18	
							20	
							22	
							24	
							26	
							28	

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-4

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
								Weeds
					SP		0	Sand - Brn, slightly silty, dry, fine to med., pebbles, slighlty porous
3	Standard penetration test						2	- Very loose
							4	
							6	
6	Standard penetration test				SP-SM		8	- Brn, silty, fine to med. coarse, moist
					SP			- Gray brn, fine to med. coarse, rock frag., pebbles, moist, slightly silty
	California sampler	8.0	126	95			10	
							12	

	Site Location	Plate #
Groundwater: None Approx. Depth of Bedrock: None Datum: N/A Elevation: N/A	NEC Center & Mt Vernon Riverside County	

Bulk/Grab sample — California sampler — Standard penetration test

Soils Southwest, Inc.
897 Via Lata, Suite N
Colton, CA 92324
(909) 370-0474 Fax (909) 370-3156

LOG OF BORING B-4

Project: Victoria Homes / Tr.32989		Job No.: 05156-F
Logged By: John	Boring Diam.: 8"	Date: 29 Jun 05

Standard Penetration (Blows per Ft.)	Sample Type	Water Content in %	Dry Density in PCF	Percent Compaction	Unified Classification System	Graphic	Depth in Feet	Description and Remarks
							14	- Lt brn, slightly silty, fine to med. coarse, pebbles, rock frag.
27								
							16	- End of boring @ 16' No bedrock No groundwater
							18	
							20	
							22	
							24	
							26	
							28	

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
(symbol)	Poorly graded sand with silt
(symbol)	Poorly graded sand
Soil Samplers	
(symbol)	Bulk/Grab sample
(symbol)	California sampler
(symbol)	Standard penetration test

Notes:

1. Exploratory borings were drilled on 29 Jun 05 using a 4-inch diameter continuous flight power auger.

2. No free water was encountered at the time of drilling or when re-checked the following day.

3. Boring locations were taped from existing features and elevations extrapolated from the final design schematic plan.

4. These logs are subject to the limitations, conclusions, and recommendations in this report.

5. Results of tests conducted on samples recovered are reported on the logs.

8.0 APPENDIX B

Laboratory Test Programs

Laboratory tests were conducted on representative soils for the purpose of classification and for the determination of the physical properties and engineering characteristics. The number and selection of the types of testing for a given study are based on the geotechnical conditions of the site. A summary of the various laboratory tests performed for the project is presented below.

Moisture Content and Dry Density (D2937):

Data obtained from these test, performed on undisturbed samples are used to aid in the classification and correlation of the soils and to provide qualitative information regarding soil strength and compressibility.

Direct Shear (D3080):

Data obtained from this test performed at increased and field moisture conditions on relatively remolded soil sample is used to evaluate soil shear strengths. Samples contained in brass sampler rings, placed directly on test apparatus are sheared at a constant strain rate of 0.002 inch per minute under saturated conditions and under varying loads appropriate to represent anticipated structural loadings. Shearing deformations are recorded to failure. Peak and/or residual shear strengths are obtained from the measured shearing load versus deflection curve. Test results, plotted on graphical form, are presented on Plate B-1 of this section.

Consolidation (D2835):

Drive-tube samples are tested at their field moisture contents and at increased moisture conditions since the soils may become saturated during life-time use of the planned structure.

Data obtained from this test performed on relatively undisturbed and/or remolded samples, were used to evaluate the consolidation characteristics of foundation soils under anticipated foundation loadings. Preparation for this test involved trimming the sample, placing it in one inch high brass ring, and loading it into the test apparatus which contained porous stones to accommodate drainage during testing. Normal axial loads are applied at a load increment ratio, successive loads being generally twice the preceding.

Soil samples are usually under light normal load conditions to accommodate seating of the apparatus. Samples were tested at the field moisture conditions at a predetermined normal load. Potentially moisture sensitive soil typically demonstrated significant volume change with the introduction of free water. The results of the consolidation tests are presented in graphical forms on Plate B-2.

Potential Expansion

Considering sandy nature, the site soils are considered non-expansive in contact with water, and consequently, no expansion tests are performed and none such are considered necessary at this time.

Laboratory Test Results

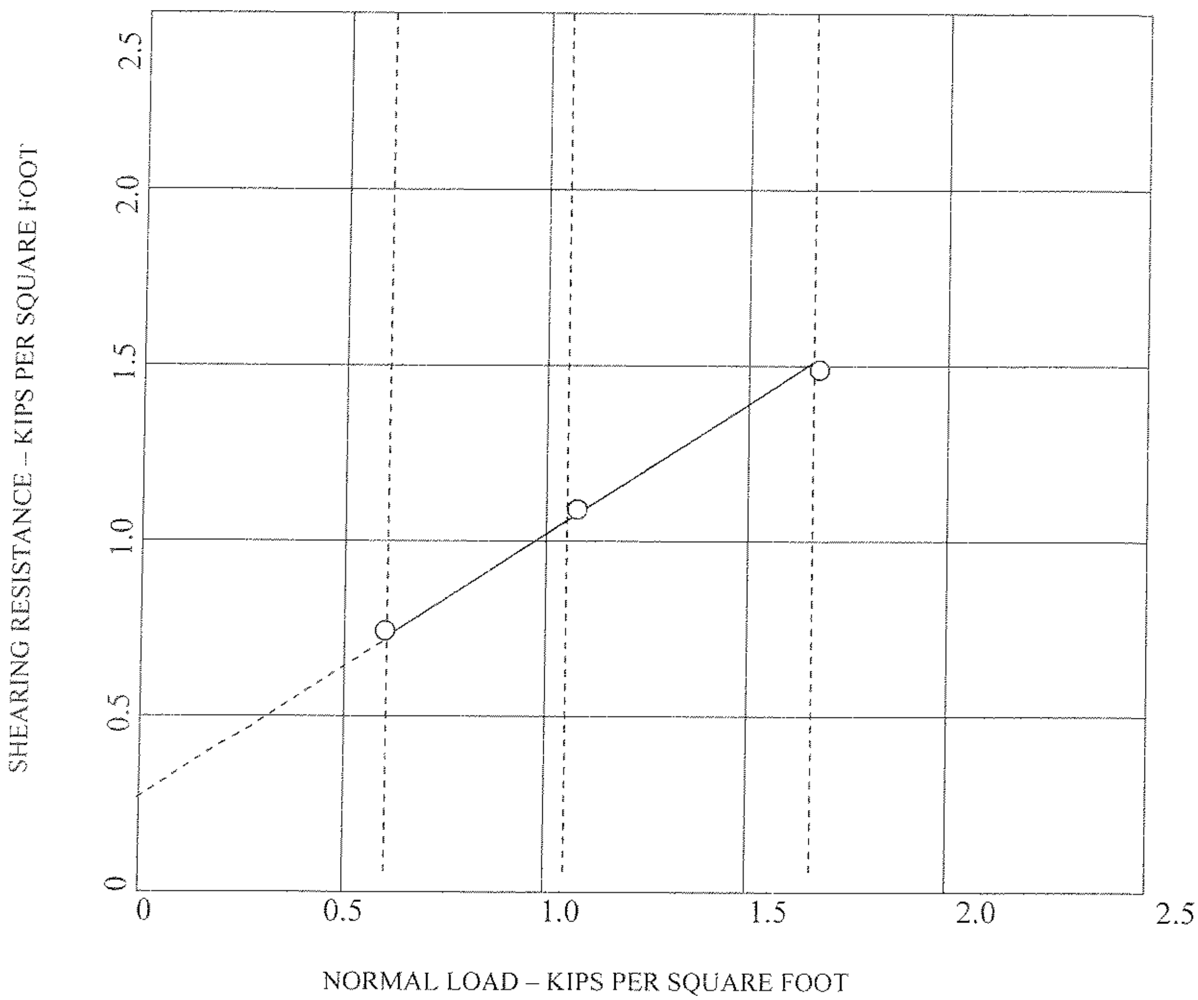
Table I: In-Situ Moisture-Density

Test Boring No.	Sample Depth, ft.	Dry Density, pcf.	Moisture Content, %
1	3.0	107	4.0
1	8.0	120	4.5
2	5.0	117	8.0
4	10.0	126	8.0

Table III: Max. Density/Optimum Moisture Content (ASTM D1557-91)

Sample Location, @ Depth, ft.	Max. Dry Density, pcf	Opt. Moisture (%)
B-1 @ 0-3	133	9.0

DIRECT SHEAR TESTS

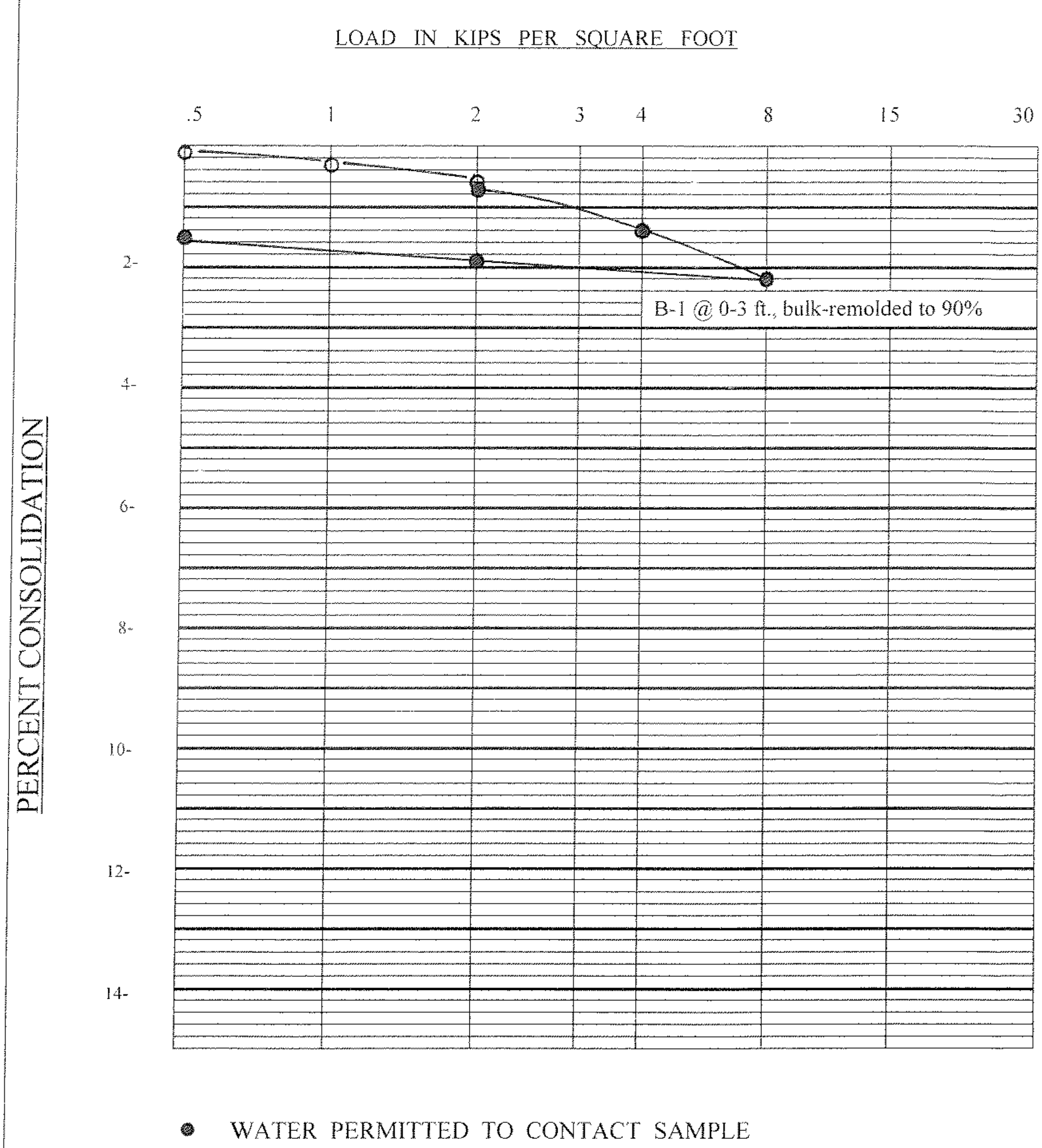


SYMBOL	LOCATION	DEPTH (ft)	TEST CONDITION	COHESION (psf)	FRICTION (degree)
○	B-1	0-3	Bulk-remolded to 90%	275	33

Proposed Single Family Tract 32989 NEC Center Street & Mt Vernon Avenue Highgrove area, Riverside County, California	PROJECT NO.	05156-F
	PLATE	B-1

SOILS SOUTHWEST INC.
Consulting Foundation Engineers

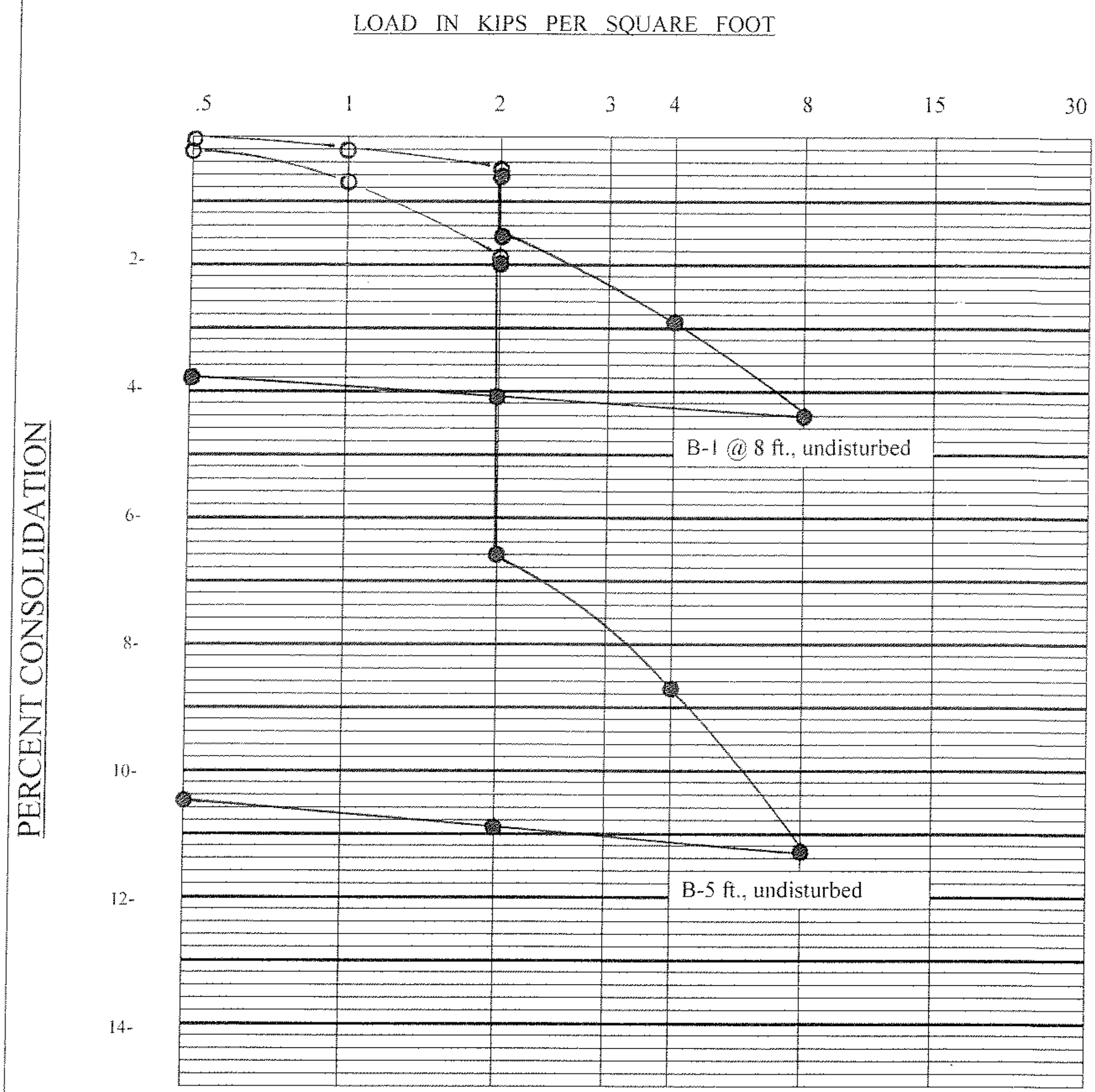
CONSOLIDATION TESTS



Proposed Single Family Tract 32989 NEC Center Street & Mt Vernon Avenue Highgrove area, Riverside County, California	PROJECT NO.	05156-F
	PLATE	B-2

SOILS SOUTHWEST INC.
Consulting Foundation Engineers

CONSOLIDATION TESTS



● WATER PERMITTED TO CONTACT SAMPLE

Proposed Single Family Tract 32989 NEC Center Street & Mt Vernon Avenue Highgrove area, Riverside County, California	PROJECT NO.	05156-F
	PLATE	B-2-1

SOILS SOUTHWEST INC.
Consulting Foundation Engineers

Appendix C

Supplemental Seismic Design Parameters

```
***********************
*                     *
*    U B C S E I S    *
*                     *
*    Version  1.03    *
*                     *
***********************
```

COMPUTATION OF 1997
UNIFORM BUILDING CODE
SEISMIC DESIGN PARAMETERS

JOB NUMBER: 05156-F DATE: 07-12-2005

JOB NAME: Paradigm, Co., LLC NEC Center & Mt Vernon Riverside Cnty

FAULT-DATA-FILE NAME: CDMGUBCR.DAT

SITE COORDINATES:
SITE LATITUDE: 34.0164
SITE LONGITUDE: 117.3122

UBC SEISMIC ZONE: 0.4

UBC SOIL PROFILE TYPE: SD

NEAREST TYPE A FAULT:
NAME: SAN ANDREAS - Southern
DISTANCE: 18.8 km

NEAREST TYPE B FAULT:
NAME: SAN JACINTO-SAN BERNARDINO
DISTANCE: 4.2 km

NEAREST TYPE C FAULT:
NAME:
DISTANCE: 99999.0 km

SELECTED UBC SEISMIC COEFFICIENTS:
Na: 1.1
Nv: 1.3
Ca: 0.48
Cv: 0.83
Ts: 0.702
To: 0.140

```
*******************************************************************
* CAUTION:  The digitized data points used to model faults are    *
*           limited in number and have been digitized from small- *
*           scale maps (e.g., 1:750,000 scale).  Consequently,    *
*           the estimated fault-site-distances may be in error by *
*           several kilometers.  Therefore, it is important that  *
*           the distances be carefully checked for accuracy and   *
*           adjusted as needed, before they are used in design.   *
*******************************************************************
```

SUMMARY OF FAULT PARAMETERS

ABBREVIATED FAULT NAME	APPROX. DISTANCE (km)	SOURCE TYPE (A,B,C)	MAX. MAG. (Mw)	SLIP RATE (mm/yr)	FAULT TYPE (SS,DS,BT)
SAN JACINTO-SAN BERNARDINO	4.2	B	6.7	12.00	SS
SAN JACINTO-SAN JACINTO VALLEY	6.9	B	6.9	12.00	SS
SAN ANDREAS - Southern	18.8	A	7.4	24.00	SS
CUCAMONGA	21.8	A	7.0	5.00	DS
NORTH FRONTAL FAULT ZONE (West)	28.4	B	7.0	1.00	DS
CLEGHORN	28.9	B	6.5	3.00	SS
CHINO-CENTRAL AVE. (Elsinore)	31.4	B	6.7	1.00	DS
ELSINORE-GLEN IVY	33.3	B	6.8	5.00	SS
ELSINORE-WHITTIER	35.0	B	6.8	2.50	SS
SAN JOSE	36.5	B	6.5	0.50	DS
SAN ANDREAS - 1857 Rupture	38.4	A	7.8	34.00	SS
SIERRA MADRE (Central)	41.1	B	7.0	3.00	DS
ELSINORE-TEMECULA	41.7	B	6.8	5.00	SS
SAN JACINTO-ANZA	47.7	A	7.2	12.00	SS
NORTH FRONTAL FAULT ZONE (East)	53.1	B	6.7	0.50	DS
PINTO MOUNTAIN	54.5	B	7.0	2.50	SS
CLAMSHELL-SAWPIT	55.1	B	6.5	0.50	DS
HELENDALE - S. LOCKHARDT	56.7	B	7.1	0.60	SS
RAYMOND	66.0	B	6.5	0.50	DS
NEWPORT-INGLEWOOD (Offshore)	72.1	B	6.9	1.50	SS
NEWPORT-INGLEWOOD (L.A.Basin)	72.4	B	6.9	1.00	SS
LENWOOD-LOCKHART-OLD WOMAN SPRGS	72.8	B	7.3	0.60	SS
VERDUGO	75.0	B	6.7	0.50	DS
ELSINORE-JULIAN	76.3	A	7.1	5.00	SS
JOHNSON VALLEY (Northern)	80.9	B	6.7	0.60	SS
BURNT MTN.	83.9	B	6.5	0.60	SS
LANDERS	84.1	B	7.3	0.60	SS
HOLLYWOOD	85.4	B	6.5	1.00	DS
EUREKA PEAK	85.5	B	6.5	0.60	SS
PALOS VERDES	90.7	B	7.1	3.00	SS
EMERSON So. - COPPER MTN.	91.6	B	6.9	0.60	SS
SIERRA MADRE (San Fernando)	95.1	B	6.7	2.00	DS
SAN GABRIEL	95.3	B	7.0	1.00	SS
SAN JACINTO-COYOTE CREEK	96.8	B	6.8	4.00	SS
ROSE CANYON	99.1	B	6.9	1.50	SS
CORONADO BANK	100.6	B	7.4	3.00	SS
SANTA MONICA	101.3	B	6.6	1.00	DS
CALICO - HIDALGO	101.3	B	7.1	0.60	SS
GRAVEL HILLS - HARPER LAKE	101.9	B	6.9	0.60	SS
PISGAH-BULLION MTN.-MESQUITE LK	108.7	B	7.1	0.60	SS
MALIBU COAST	112.3	B	6.7	0.30	DS
SANTA SUSANA	114.3	B	6.6	5.00	DS
EARTHQUAKE VALLEY	114.7	B	6.5	2.00	SS
BLACKWATER	115.3	B	6.9	0.60	SS
HOLSER	122.3	B	6.5	0.40	DS
ANACAPA-DUME	127.5	B	7.3	3.00	DS

SUMMARY OF FAULT PARAMETERS

ABBREVIATED FAULT NAME	APPROX. DISTANCE (km)	SOURCE TYPE (A,B,C)	MAX. MAG. (Mw)	SLIP RATE (mm/yr)	FAULT TYPE (SS,DS,BT)
OAK RIDGE (Onshore)	135.8	B	6.9	4.00	DS
SAN JACINTO - BORREGO	137.3	B	6.6	4.00	SS
SIMI-SANTA ROSA	140.3	B	6.7	1.00	DS
SAN CAYETANO	141.6	B	6.8	6.00	DS
ELSINORE-COYOTE MOUNTAIN	146.1	B	6.8	4.00	SS
GARLOCK (West)	150.6	A	7.1	6.00	SS
GARLOCK (East)	155.5	A	7.3	7.00	SS
SANTA YNEZ (East)	158.8	B	7.0	2.00	SS
BRAWLEY SEISMIC ZONE	165.6	B	6.5	25.00	SS
PLEITO THRUST	170.1	B	6.8	2.00	DS
SUPERSTITION MTN. (San Jacinto)	171.4	B	6.6	5.00	SS
VENTURA - PITAS POINT	172.5	B	6.8	1.00	DS
ELMORE RANCH	173.5	B	6.6	1.00	SS
SUPERSTITION HILLS (San Jacinto)	175.8	B	6.6	4.00	SS
So. SIERRA NEVADA	178.0	B	7.1	0.10	DS
M.RIDGE-ARROYO PARIDA-SANTA ANA	178.1	B	6.7	0.40	DS
WHITE WOLF	179.0	B	7.2	2.00	DS
LITTLE LAKE	179.9	B	6.7	0.70	SS
BIG PINE	180.0	B	6.7	0.80	SS
TANK CANYON	180.8	B	6.5	1.00	DS
OWL LAKE	181.3	B	6.5	2.00	SS
PANAMINT VALLEY	181.4	B	7.2	2.50	SS
RED MOUNTAIN	186.4	B	6.8	2.00	DS
ELSINORE-LAGUNA SALADA	194.9	B	7.0	3.50	SS
DEATH VALLEY (South)	195.4	B	6.9	4.00	SS
IMPERIAL	201.9	A	7.0	20.00	SS
SANTA CRUZ ISLAND	203.1	B	6.8	1.00	DS
SANTA YNEZ (West)	220.1	B	6.9	2.00	SS
DEATH VALLEY (Graben)	231.5	B	6.9	4.00	DS
SANTA ROSA ISLAND	239.1	B	6.9	1.00	DS
OWENS VALLEY	249.6	B	7.6	1.50	SS
LOS ALAMOS-W. BASELINE	262.7	B	6.8	0.70	DS
HUNTER MTN. - SALINE VALLEY	273.8	B	7.0	2.50	SS
SAN JUAN	274.6	B	7.0	1.00	SS
LIONS HEAD	279.8	B	6.6	0.02	DS
SAN LUIS RANGE (S. Margin)	283.5	B	7.0	0.20	DS
DEATH VALLEY (Northern)	284.2	A	7.2	5.00	SS
INDEPENDENCE	285.5	B	6.9	0.20	DS
CASMALIA (Orcutt Frontal Fault)	295.7	B	6.5	0.25	DS
LOS OSOS	312.8	B	6.8	0.50	DS
HOSGRI	325.5	B	7.3	2.50	SS
RINCONADA	327.8	B	7.3	1.00	SS
BIRCH CREEK	342.3	B	6.5	0.70	DS
WHITE MOUNTAINS	346.1	B	7.1	1.00	SS
DEEP SPRINGS	363.9	B	6.6	0.80	DS
DEATH VALLEY (N. of Cucamongo)	368.0	A	7.0	5.00	SS

SUMMARY OF FAULT PARAMETERS

Page 3

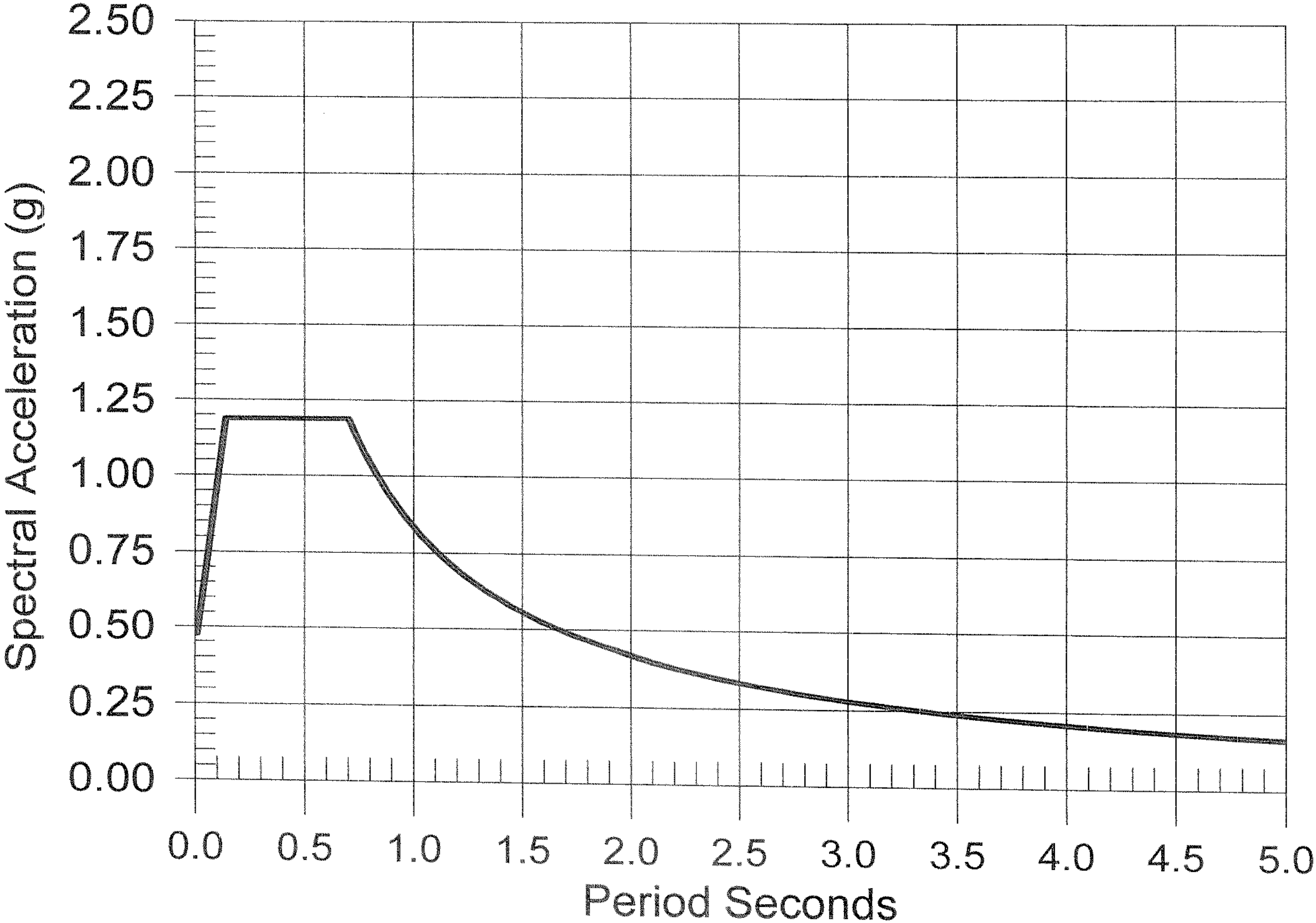
ABBREVIATED FAULT NAME	APPROX. DISTANCE (km)	SOURCE TYPE (A,B,C)	MAX. MAG. (Mw)	SLIP RATE (mm/yr)	FAULT TYPE (SS,DS,BT)
SAN ANDREAS (Creeping)	372.0	B	5.0	34.00	SS
ROUND VALLEY (E. of S.N.Mtns.)	378.4	B	6.8	1.00	DS
FISH SLOUGH	385.0	B	6.6	0.20	DS
HILTON CREEK	404.7	B	6.7	2.50	DS
HARTLEY SPRINGS	429.7	B	6.6	0.50	DS
ORTIGALITA	450.2	B	6.9	1.00	SS
CALAVERAS (So.of Calaveras Res)	459.5	B	6.2	15.00	SS
MONO LAKE	465.9	B	6.6	2.50	DS
MONTEREY BAY - TULARCITOS	468.2	B	7.1	0.50	DS
QUIEN SABE	471.5	B	6.5	1.00	SS
PALO COLORADO - SUR	473.5	B	7.0	3.00	SS
ZAYANTE-VERGELES	491.6	B	6.8	0.10	SS
SARGENT	496.0	B	6.8	3.00	SS
SAN ANDREAS (1906)	496.9	A	7.9	24.00	SS
ROBINSON CREEK	497.4	B	6.5	0.50	DS
ANTELOPE VALLEY	538.1	B	6.7	0.80	DS
GREENVILLE	541.0	B	6.9	2.00	SS
SAN GREGORIO	542.6	A	7.3	5.00	SS
HAYWARD (SE Extension)	544.2	B	6.5	3.00	SS
MONTE VISTA - SHANNON	546.0	B	6.5	0.40	DS
HAYWARD (Total Length)	563.0	A	7.1	9.00	SS
CALAVERAS (No.of Calaveras Res)	563.0	B	6.8	6.00	SS
GENOA	564.3	B	6.9	1.00	DS
CONCORD - GREEN VALLEY	608.3	B	6.9	6.00	SS
WEST NAPA	647.6	B	6.5	1.00	SS
RODGERS CREEK	647.8	A	7.0	9.00	SS
HUNTING CREEK - BERRYESSA	667.9	B	6.9	6.00	SS
POINT REYES	670.6	B	6.8	0.30	DS
MAACAMA (South)	709.2	B	6.9	9.00	SS
COLLAYOMI	724.8	B	6.5	0.60	SS
BARTLETT SPRINGS	726.6	A	7.1	6.00	SS
MAACAMA (Central)	750.7	A	7.1	9.00	SS
MAACAMA (North)	808.9	A	7.1	9.00	SS
ROUND VALLEY (N. S.F.Bay)	812.8	B	6.8	6.00	SS
BATTLE CREEK	828.2	B	6.5	0.50	DS
LAKE MOUNTAIN	871.0	B	6.7	6.00	SS
GARBERVILLE-BRICELAND	889.1	B	6.9	9.00	SS
MENDOCINO FAULT ZONE	946.7	A	7.4	35.00	DS
LITTLE SALMON (Onshore)	950.8	A	7.0	5.00	DS
MAD RIVER	952.0	B	7.1	0.70	DS
CASCADIA SUBDUCTION ZONE	961.4	A	8.3	35.00	DS
McKINLEYVILLE	962.9	B	7.0	0.60	DS
TRINIDAD	964.0	B	7.3	2.50	DS
FICKLE HILL	965.0	B	6.9	0.60	DS
TABLE BLUFF	971.6	B	7.0	0.60	DS
LITTLE SALMON (Offshore)	984.7	B	7.1	1.00	DS

SUMMARY OF FAULT PARAMETERS

ABBREVIATED FAULT NAME	APPROX. DISTANCE (km)	SOURCE TYPE (A,B,C)	MAX. MAG. (Mw)	SLIP RATE (mm/yr)	FAULT TYPE (SS,DS,BT)
BIG LAGOON - BALD MTN.FLT.ZONE	1000.3	B	7.3	0.50	DS

DESIGN RESPONSE SPECTRUM

Seismic Zone: 0.4 Soil Profile: SD



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*   Version 3.00      *
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DETERMINISTIC ESTIMATION OF
PEAK ACCELERATION FROM DIGITIZED FAULTS

JOB NUMBER: 05156-F

DATE: 07-12-2005

JOB NAME: Paradigm, Co., LLC NEC Center & Mt Vernon Riverside Cnty

CALCULATION NAME: 05156-F

FAULT-DATA-FILE NAME: CDMGFLTE.DAT

SITE COORDINATES:
SITE LATITUDE: 34.0164
SITE LONGITUDE: 117.3122

SEARCH RADIUS: 10 mi

ATTENUATION RELATION: 26) Idriss (1994) Horiz. - Soft Soil
UNCERTAINTY (M=Median, S=Sigma): M   Number of Sigmas: 0.0
DISTANCE MEASURE: rdist
SCOND: 0
Basement Depth: 5.00 km   Campbell SSR: Campbell SHR:
COMPUTE PEAK HORIZONTAL ACCELERATION

FAULT-DATA FILE USED: CDMGFLTE.DAT

MINIMUM DEPTH VALUE (km): 0.0

EQFAULT SUMMARY

DETERMINISTIC SITE PARAMETERS

Page 1

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT: MAXIMUM EARTHQUAKE MAG.(Mw)	PEAK SITE ACCEL. g	EST. SITE INTENSITY MOD.MERC.
SAN JACINTO-SAN BERNARDINO	2.6(4.2)	6.7	0.441	X
SAN JACINTO-SAN JACINTO VALLEY	4.3(6.9)	6.9	0.424	X

****

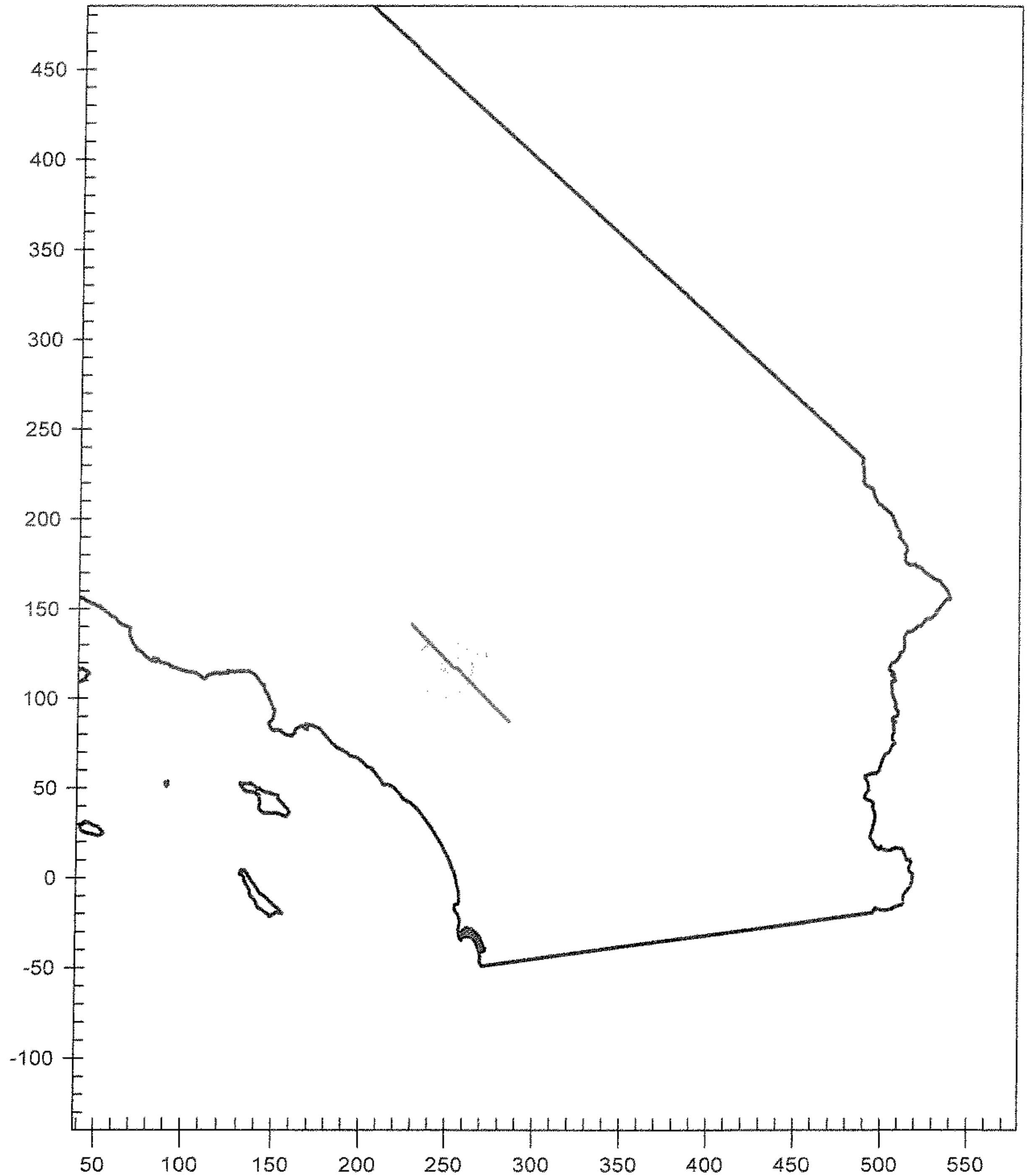
-END OF SEARCH- 2 FAULTS FOUND WITHIN THE SPECIFIED SEARCH RADIUS.

THE SAN JACINTO-SAN BERNARDINO FAULT IS CLOSEST TO THE SITE.
IT IS ABOUT 2.6 MILES (4.2 km) AWAY.

LARGEST MAXIMUM-EARTHQUAKE SITE ACCELERATION: 0.4406 g

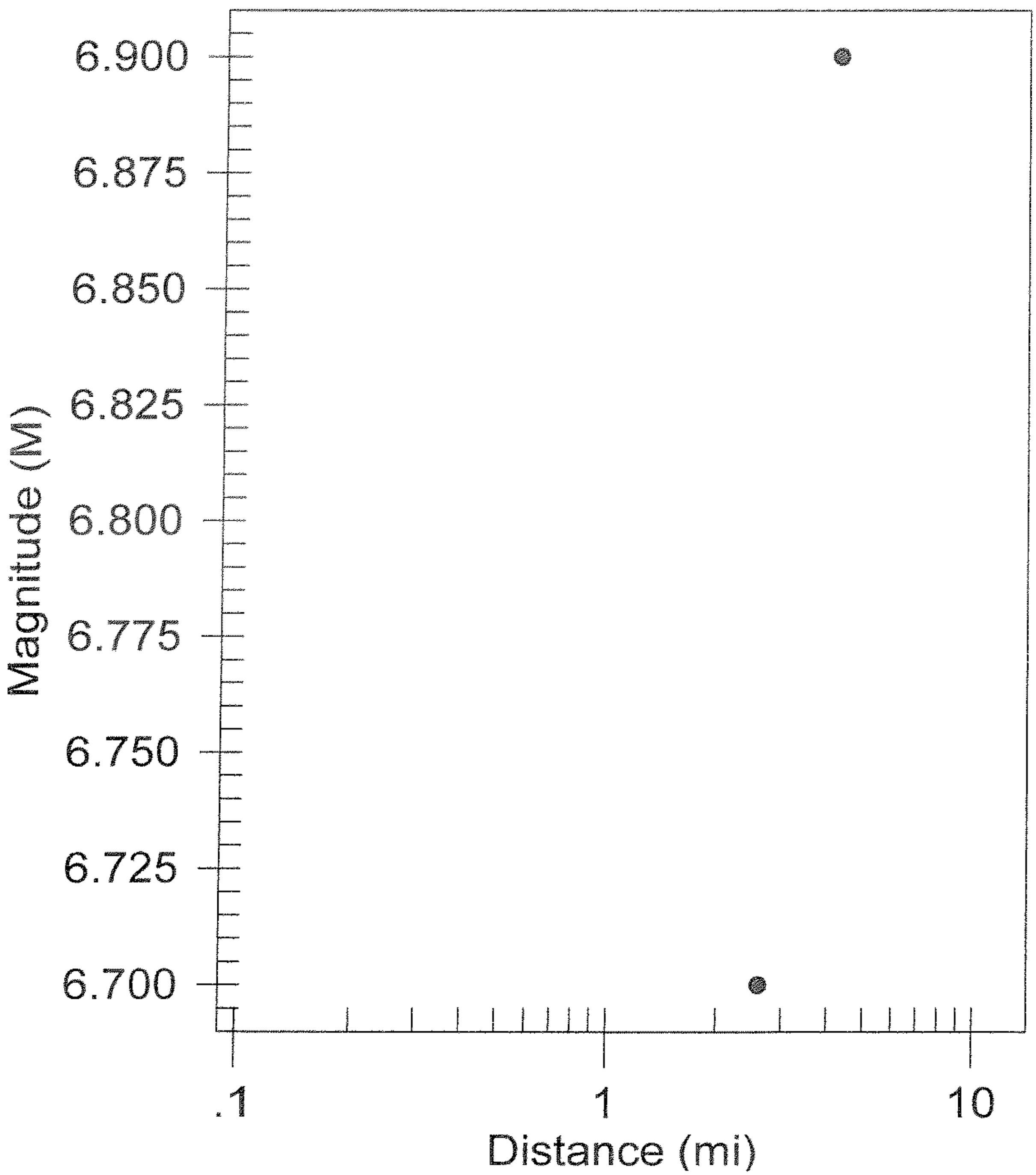
CALIFORNIA FAULT MAP

Paradigm, Co., LLC NEC Center & Mt Vernon Riverside Cnty



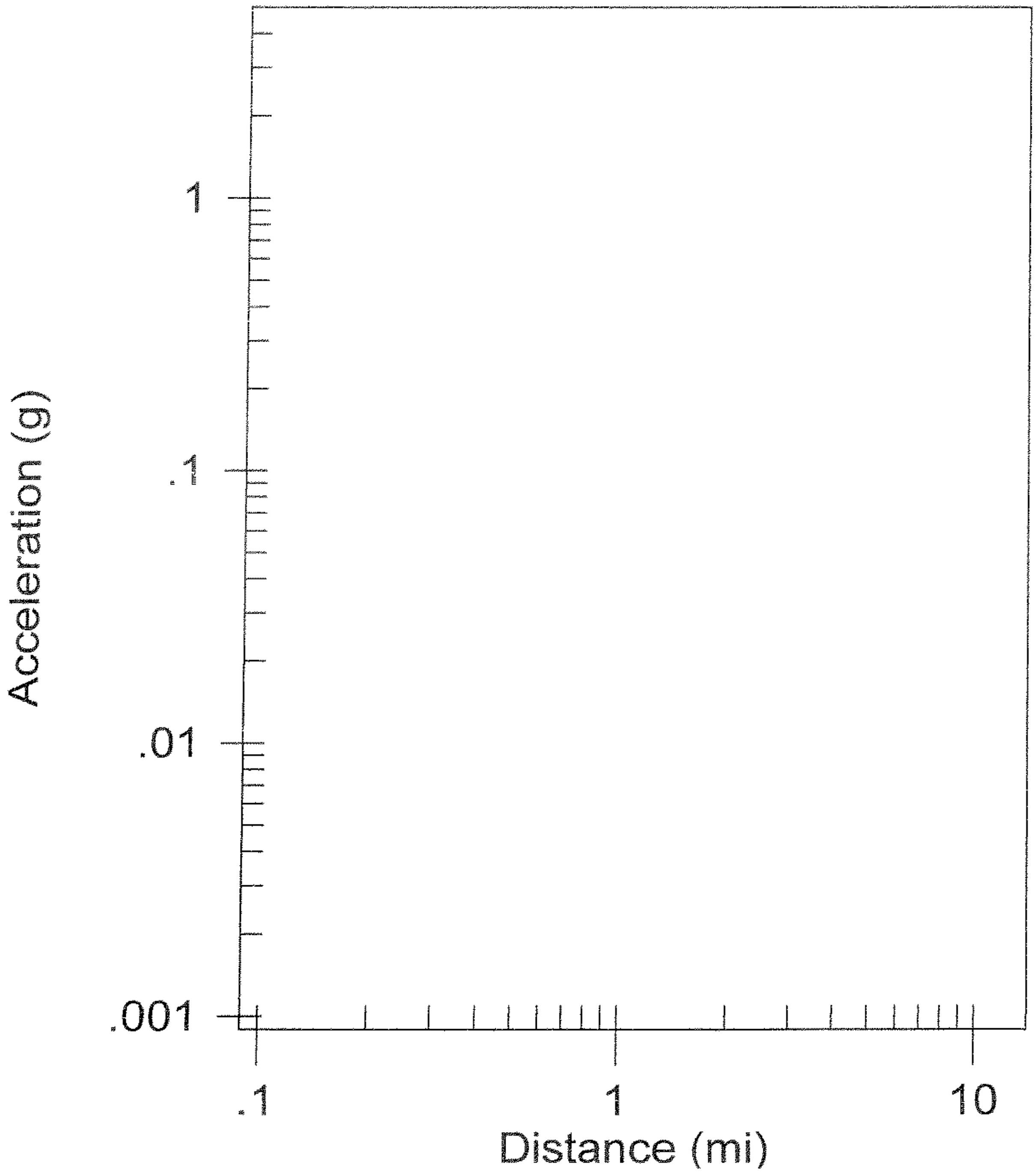
EARTHQUAKE MAGNITUDES & DISTANCES

Paradigm, Co., LLC NEC Center & Mt Vernon Riverside Cnty



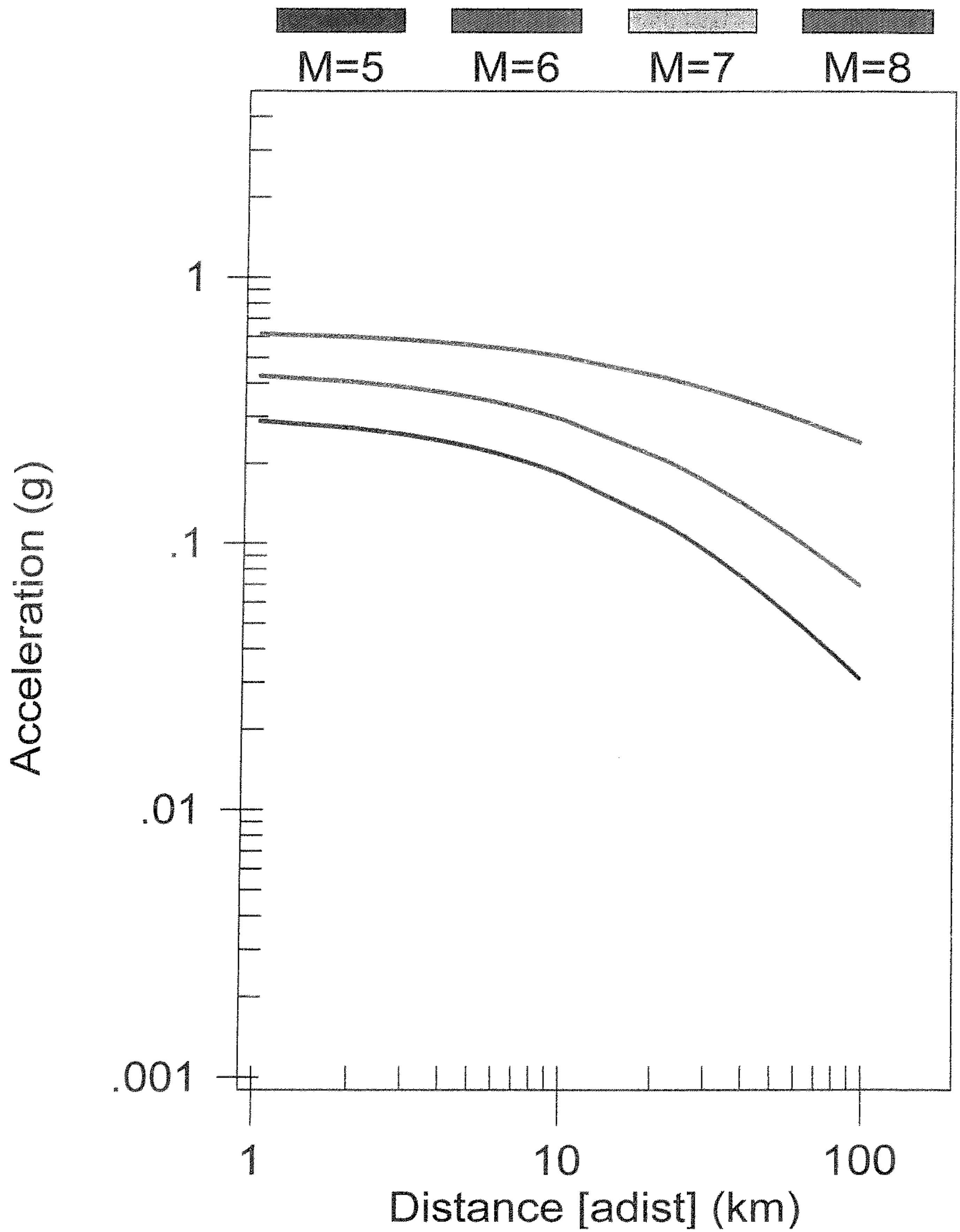
MAXIMUM EARTHQUAKES

Paradigm, Co., LLC NEC Center & Mt Vernon Riverside Cnty



STRIKE-SLIP FAULTS

26) Idriss (1994) Horiz. - Soft Soil



DIP-SLIP FAULTS

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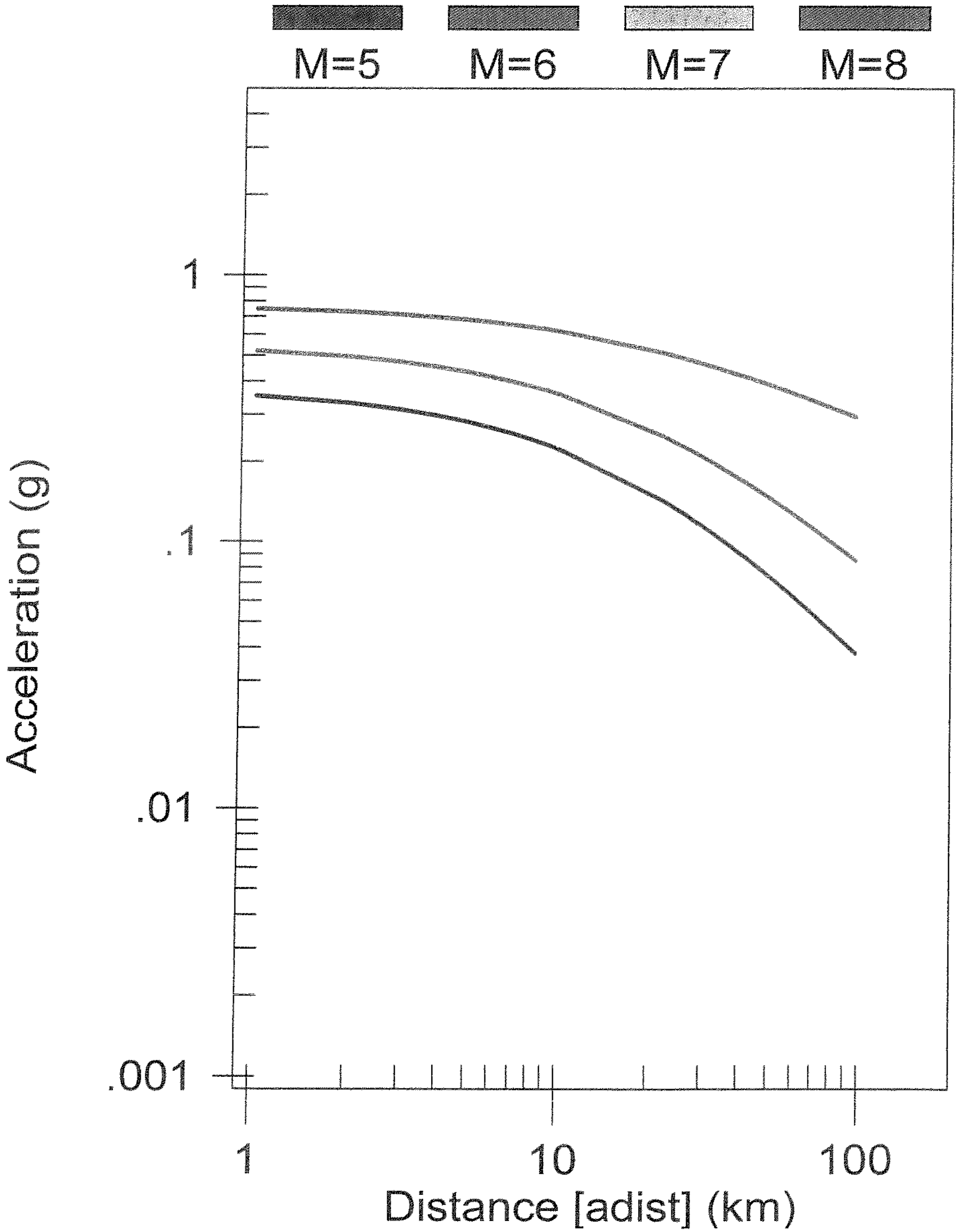

BLIND-THRUST FAULTS

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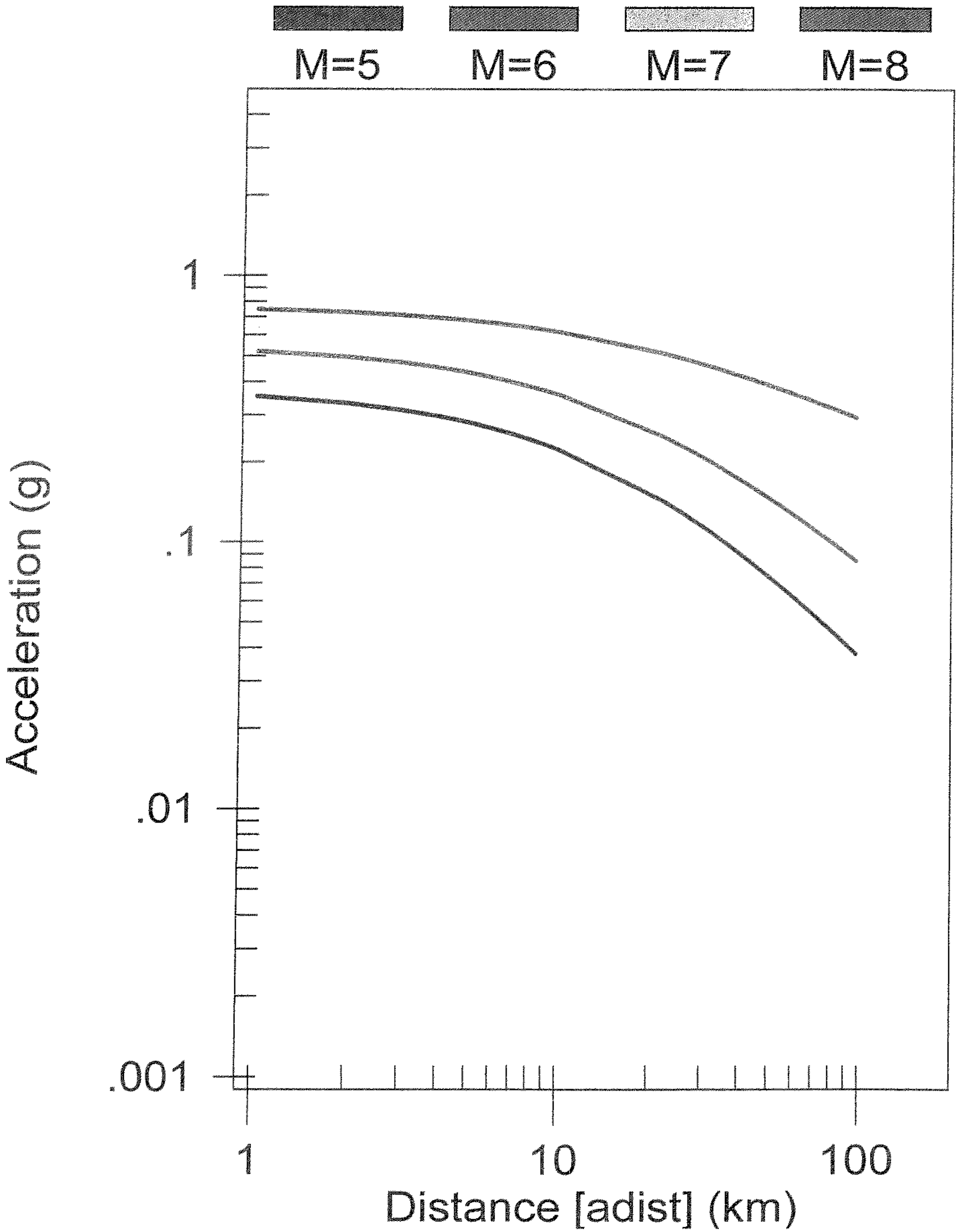
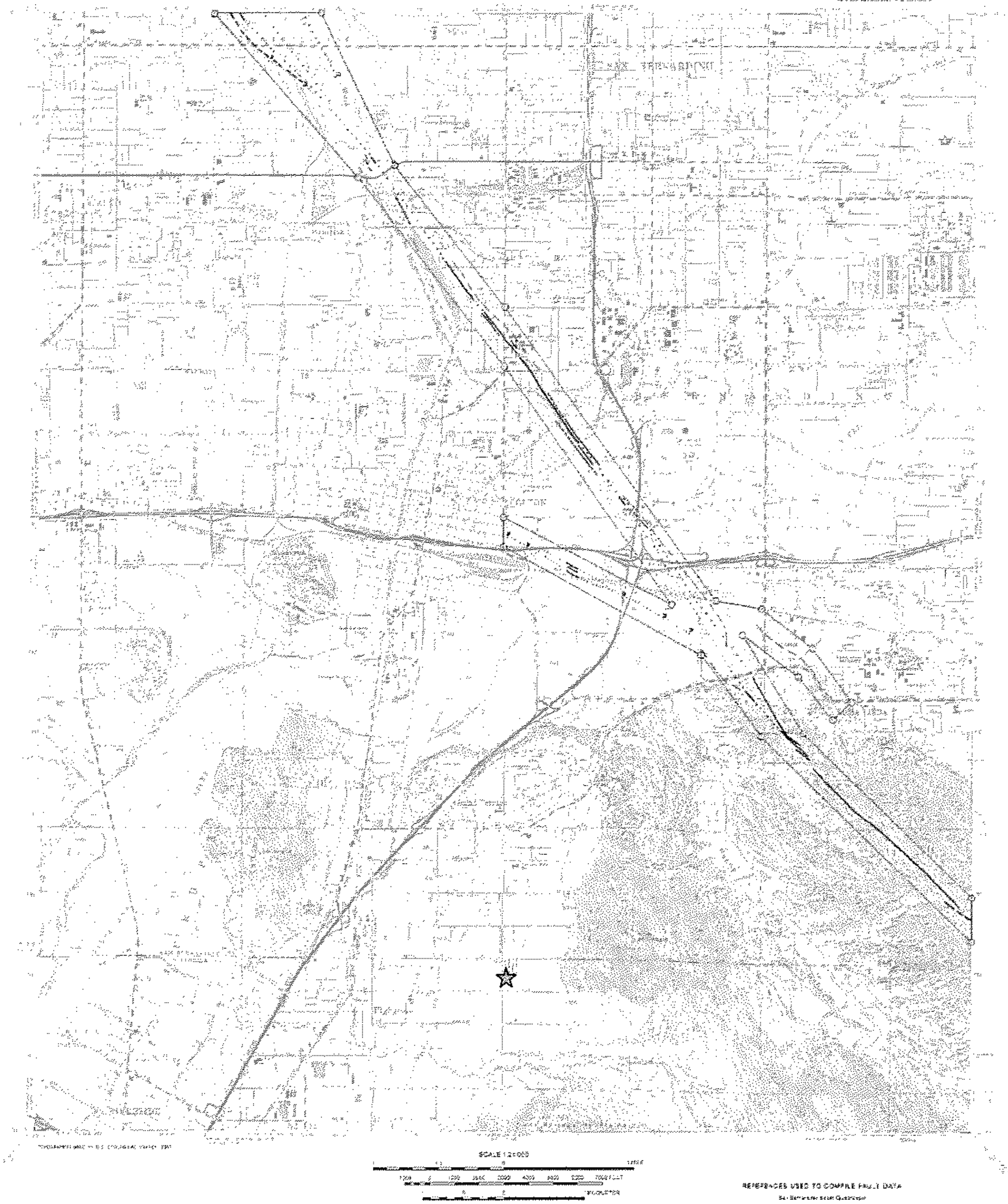


CALIFORNIA DIVISION OF MINES AND GEOLOGY
THOMAS E. GAY JR., ACTING STATE GEOLOGIST

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF CONSERVATION

SAN BERNARDINO SOUTH QUADRANGLE
CALIFORNIA



MAP EXPLANATION

Potentially Active Faults

Faults considered to have been active during Quaternary time; solid line where accurately located, long dash where approximately located, short dash where inferred, dotted where concealed; query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by creep or possible creep.

Aerial photo lineaments (not field checked); based on youthful geomorphic and other features believed to be the results of Quaternary faulting.

Special Studies Zone Boundaries

These are delineated as straight-line segments that connect encircled turning points so as to define special studies zone segments.

Seaward projection of zone boundary

STATE OF CALIFORNIA
SPECIAL STUDIES ZONES

Delineated in compliance with Chapter 7.5, Division 2 of the California Public Resources Code

SAN BERNARDINO SOUTH QUADRANGLE

REVISED OFFICIAL MAP

Effective: January 1, 1977

Acting State Geologist

REFERENCES USED TO COMPILE FAULT DATA

IMPORTANT - PLEASE NOTE

1) *This map may not show all potentially active faults, either within the special studies zones or outside their boundaries.*
2) Faults shown are the basis for establishing the boundaries of the special studies zones.
3) The identification of these potentially active faults and the location of such fault traces are based on the best available data. Traces have been drawn as accurately as possible at this map scale; however, the quality of data used is highly varied. The faults shown have not been field checked during this map compilation.
4) Fault information on this map is not sufficient to serve as a substitute for information developed by the special studies that may be required under Chapter 7.5, Division 2, Section 2623 of the California Public Resources Code.

PROFESSIONAL LIMITATIONS

Our investigation was performed using the degree of care and skill ordinarily exercised, under similar circumstances by other reputable Soils Engineers practicing in these general or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

The investigations are based on soil samples only, consequently the recommendations provided shall be considered 'preliminary'. The samples taken and used for testing and the observations made are believed representative of site conditions; however, soil and geologic conditions can vary significantly between test excavations. If this occurs, the changed conditions must be evaluated by the Project Soils Engineer and designs adjusted as required or alternate design recommended.

The report is issued with the understanding that it is the responsibility of the owner, or of his representative, to ensure that the information and recommendations contained herein are brought to the attention of the project architect and engineers. Appropriate recommendations should be incorporated into structural plans. The necessary steps should be taken to see that out such recommendations in field.

The findings of this report are valid as of this present date. However, changes in the conditions of a property can occur with the passage of time, whether they due to natural process or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur from legislation or broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by change outside of our control. Therefore, this report is subject to review and should be updated after a period of one year.

RECOMMENDED SERVICES

The review of grading plans and specifications, field observations and testing by a geotechnical representative of this office is integral part of the conclusions and recommendations made in this report. If Soils Southwest, Inc. (SSW) is not retained for these services, the Client agrees to assume SSW's responsibility for any potential claims that may arise during and after construction, or during the life-time use of the structure and its appurtenant.

The recommendations supplied should be considered valid and applicable, provided the following conditions, in minimum, are met:

i. Pre-grade meeting with contractor, public agency and soils engineer,
ii. Excavated bottom inspections and verification s by soils engineer prior to backfill placement,
iii. Continuous observations and testing during site preparation and structural fill soils placement,
iv. Observation and inspection of footing trenching prior to steel and concrete placement,
v. Subgrade verifications including plumbing trench backfills prior to concrete slab-on-grade placement,
vi. On and off-site utility trench backfill testing and verifications,
vii. Precise-grading plan review, and
viii. Consultations as required during construction, or upon your request

Soils Southwest, Inc. will assume no responsibility for any structural distresses during its life-time use; in event the above conditions are not strictly fulfilled.