Appendix D:
Feasibility Study Report of Soils and Foundation Evaluations Conducted by Soils Southwest, Inc.

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SOILS SOUTHWEST, INC.

SOILS, MATERIALS AND ENVIRONMENTAL ENGINEERING CONSULTANTS

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Feasibility Study
Report of Preliminary Soils and Foundation Evaluations

Proposed 10-parcel LuxView Apartment Complex & Club House
NWC and SWC Alabama Street and Orange Avenue
Redlands, California

Project No. 17055-F
November 28, 2018

Prepared for:

SD Homes
% Miller, AIP
1177 Idaho Street, Suite 200
Redlands, California 92374

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Established 1984

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November 28, 2018

Project No. 17055-F

SD Homes
% Miller, AIP
1177 Idaho Street, Suite 200
Redlands, California 92374

Attention: Chris Hardt

Subject: Feasibility Study Report of Soils and Foundation Investigation
Proposed 10-parcel LuxView Apartment Complex & Club House
NWC and SWC Alabama Street and Orange Avenue
Redlands, California

Reference: Conceptual Site Pan prepared by Miller, AIP

Gentlemen:

Presented herewith is the Feasibility Study Report of Soils and Foundation Evaluations conducted for the site of the proposed apartment complex and clubhouse to be constructed at northwest corner and southwest corners of Alabama Street and Orange Avenue, City of Redlands, California. In absence of grading and development plan review, along with the site being inaccessible due to numerous fencing, structures and operating current businesses, the opinions and recommendations included should be considered "preliminary", subject to revision and or upgrading following supplemental geotechnical explorations.

Based on the geotechnical investigation completed at this time, it is our opinion that the soils encountered primarily consists of upper disturbed, loose and compressible silty fine to medium coarse sands with pebbles and occasional rocks, overlying medium dense to dense fine to medium coarse silty sands with scattered rock fragments and rocks to the maximum 31 feet depth explored. No shallow-depth groundwater was encountered. Based on review of the available USGS published documents, it is our understanding that the site is not situated within an A-P Special Studies Zone, and with historical groundwater table at a depth in excess of 100 feet, the site is considered non-susceptible to earthquake induced potential for soils liquefaction.

Based on test borings and subsequent geotechnical evaluations completed, it is our opinion that from geotechnical view point, the proposed development should be considered feasible provided the recommendations supplied are considered in design and construction.

Thank you for the opportunity to be of service on this project. If any questions, please call the undersigned at your convenience.

Respectfully submitted,
Soils Southwest, Inc.

Moloy Gupta, RCE 31708

REGISTERED PROFESSIONAL ENGINEER
MOLOY K. GUPTA
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1.0 Introduction

Presented herewith are the results of Preliminary Soils and Foundation Evaluations conducted for the site of the proposed apartment complex and clubhouse to be constructed at northwest corner and southwest corners of Alabama Street and Orange Avenue, City of Redlands, California. Recommendations included should be considered as "preliminary", subject to review of the detailed grading plan when supplied.

The purpose of this geotechnical investigation is to determine the nature and engineering properties of the near grade and subsurface soils, and to provide tentative geotechnical recommendations for structural design and site preparations during grading.

The opinions and recommendations supplied are based on subsurface explorations, soil sampling, laboratory testing and necessary engineering analyses as completed at this time. The recommendations contained reflect our best estimate of the soils conditions as encountered during field explorations and the laboratory testing completed at this time. It is not to be considered as a warranty of the soils conditions for other areas or for the depths beyond the excavations made at this time.

The preliminary recommendations supplied should be considered valid and applicable when, in minimum, the following conditions are met:

i. Pre-grade meeting with contractor, public agencies and soils engineer,
ii. Excavated bottom inspections and verifications by soils engineer prior to backfill placement,
iii. 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.

1.1 Proposed Development

No topographic and/or detailed grading plans are prepared and none such are available at this time for our review and use. However, based on the tentative information supplied, it is understood that the subject project will primarily include six (6) multi-story apartment/condominium structures along with a club house of conventional wood-frame and stucco construction with concrete slab-on-grade. Supplemental construction is anticipated to include WQMP infiltration design system, parking/paving, curb, gutter and flatworks. Following clearance of existing structures and vegetation, moderate site preparations and grading should be anticipated with the development planned.

1.2 Site Description

The near level irregularly shaped parcels are currently occupied by existing landscape business yard, single family residences, citrus groves, and vacant property on the north along with vacant and undeveloped on the south. In general, the site is bounded by Morrey Arroyo channel and vacant undeveloped property on the north, by Orange Avenue and single-family residential on the south, by Alabama Street on the East, and Iowa Street and apartment complex on the west. With the exception of existing single family dwellings, outbuildings, nursery inventory and equipment, citrus agriculture, old building slabs, and perimeter fencing, no other significant features were noted.

2.0 Scope of Work

Geotechnical evaluations among others, included subsurface explorations using truck-mounted drilling rig, soil sampling, necessary laboratory testing, engineering analyses and the preparation of this report. Being beyond scope of work, no geologic or environmental evaluations are included. Reports on such will be supplied, if and, when requested.

In general, our scope of work included the following tasks:

- Review of the referenced site plan supplied,
- Exploratory test boring using a drillrig advanced to maximum 31 feet below grade. During explorations, the soils encountered were continuously logged, bulk and undisturbed samples were procured and SPT (Standard Penetration Test) blow-counts were recorded. Collected samples were subsequently transferred to our laboratory for necessary testing.

Descriptions of the soils encountered with SPT blow-counts are provided on the Log of Borings attached. Approximate test locations are shown on the attached Plate A.

- Laboratory testing conducted on the selected bulk and undisturbed samples were programmed according to the project requirements. The laboratory testing included determinations of:

  Moisture-Density (ASTM D2937),
  Maximum Dry Density and Optimum Moisture Content (ASTM D1557),
  Soil's Peak and Residual Shear Strengths (ASTM D3080),
  Consolidation Characteristics (ASTM D2435), and

  Description of the test results and test procedures used are provided in Appendix B of this report.

- Based on the field investigation and laboratory testing completed the necessary engineering analyses and evaluations were made on which to base our preliminary recommendations for foundation design, slab-on-grade, site preparations and grading, utility trench backfills and others, and the
- Preparation of this report for initial use by the project design professionals.

The recommendations supplied should be considered as "tentative" and may require revisions and/or upgrading following review of final grading and development plans, when supplied.

3.0 Site Conditions

3.1 Subsurface Conditions

Based on the test excavations completed, it is our opinion that the site soils primarily consist of disturbed, loose and compressible silty fine to medium sands with pebbles and occasional rock fragments, overlying medium dense to dense fine to medium coarse silty sands with scattered rock fragments and rock to the maximum 31 feet depth explored. No shallow-depth bedrock or groundwater was encountered.

Based on the test explorations and laboratory testing completed at this time, it is our opinion that with the presence of the low-density soils existing, the upper soils up to about 5 to 6 feet below the current grade surface should be considered inadequate for structural support without excessive total and differential settlements to load bearing footings and concrete-slab-grade. When, however, graded in form subexcavations of the upper loose soils and their replacement as engineered fills compacted to minimum 90% of the soils Maximum Dry Density, the local soils thus used, should be considered adequate for structural support with acceptable tolerable settlements to foundations.

3.1.2 Soil Expansion Characteristics

In general, the silty sandy in nature, the site soils encountered are considered non-expansive in characteristics. Supplemental soil expansion potential verifications are recommended during grading and construction

3.2 Excavatability

It is our opinion that the grading required for the project may be accomplished using conventional heavy-duty construction equipment. No blasting or jack-hammering should be anticipated.

3.3 Subsurface Variations

It is our opinion that variations in subsoil continuity and depths of subsoil deposits may be expected. Due to the nature and depositional characteristics of the underlying soils, care should be exercised in interpolating or extrapolating of the subsurface conditions existing in between and beyond the test explorations as described.

3.4 Soil Corrosivity Analyses

Since during mass grading, local soil matrix and their chemical compositions are expected to change considerably, no soil chemical analysis is included at this time. It is recommended that during and/or following mass grading, representative site soils should be laboratory tested to determine pH, sulfate, chloride and resistivity. Results of such will be provided on request.

3.5 Groundwater

No shallow depth groundwater was encountered and none such is anticipated during construction. The following historical groundwater information is as supplied by the local reporting agency.

GROUNDWATER TABLE	
Reporting Agency	Water Master Support Services-San Bernardino Valley Conservation District/Western Municipal Water District Cooperative Well Measuring Program, Fall 2016
Well Number	01S/03W-32J002S Lee Well
Well Monitoring Agency	City of Redlands
Well Location: Township/Range/Section	T2S-R2W-Section 14
Well Elevation:	1,357
Current Depth to Water (Measured in feet)	229
Current Date Water was Measured	November 13,2016
Depth to Water (Measured in feet) (Shallowest)	163
Date Water was Measured (Shallowest)	May 8, 2008

3.6 Faulting and Seismicity

3.6.1 Direct or Primary Seismic Hazards

With the nearest San Jacinto-San Bernardino earthquake fault at about 2.8 miles, the site is considered not situated within an A-P Special Study Zone. However, as per the current CBC, the site is located within Seismic Zone 4, where it is likely that during life expectancy of the subject project, moderate to severe ground shaking may be anticipated. It is our opinion that, adverse effect of ground-shaking may be minimized by using the seismic design parameters as described in the current CBC and as described herein.

3.6.2 Induced or Secondary Seismic Hazards

In addition to ground shaking, effects of seismic activity may include surface fault rupture, differential settlements, ground lurching, and lateral spreading. Results of site specific hazard potentials are as described below:

3.6.2.1 Surface Fault Rupture

The potential for surface rupture resulting from nearby fault movement is not known for certainty, but in our opinion, such potential should be considered due to the proximity to the nearby San Jacinto-San Bernardino earthquake fault at about 2.8 miles. If warranted, supplemental earthquake fault evaluations will be supplied on request.

3.6.2.2 Flooding

Flooding hazards include tsunamis (seismic sea waves), seiches, and failure of manmade reservoirs, tanks and aqueducts. With the absence of nearby bodies of water such as pond, lake or water tank, it is our opinion that the potential for flooding due to seismic hazards should be considered as remote.

3.6.2.3 Land-Sliding

Seismically induced landslides and other slope failures are common occurrences during or soon after and earthquake. By visual observations of the project site area, it is our opinion that existence of land sliding is not currently obvious. If warranted, potential for such hazards may be estimated by a registered geologist along with its remediation, if applicable.

3.6.2.4 Lateral Spreading

Seismically induced lateral spreading involves lateral movement of existing soils due to ground shaking. Lateral spreading is demonstrated by near vertical cracks with predominantly horizontal movement of the soil mass involved. Considering near level existing grades, it is our opinion that the potential for seismically induced lateral-spreading should be considered remote.

3.6.2.5 Liquefaction

Liquefaction is caused by build-up of excess hydrostatic pressures in saturated cohesion-less soils due to cyclic stress generated by ground shaking during an earthquake. The significant factors on which soil liquefaction potential depends include, among others, the soil type, soil relative density, intensity of earthquake, duration of ground-shaking, and depth of groundwater.

Considering the cohesive silty sands along with the historical groundwater table at a depth in excess of 100 feet, it is our opinion that potential site soils liquefaction susceptibility during an earthquake should be considered remote.

3.7 Seismic Design Coordinates

The design spectrum was developed based on the 2016 CBC. Site Coordinates of 34.051937°N, -117.209867° W were used to establish the seismic parameters presented below

3.8 Seismic Design Coefficients as per 2016 CBC

The site is situated at about 2.8 miles from the San Jacinto-San Bernardino Fault.

Recommended values are based upon the USGS ASCE 7-10 (March 2013 erata) Parameters and the California Geologic Survey: PSHA Ground Motion Interpolator Supplemental seismic parameters are provided in Appendix A of this report. In design, vertical acceleration may be assumed to about 1/3 to 2/3 of the estimated horizontal ground accelerations as described.

It should be noted that lateral force requirements in design by structural engineer should be intended to resist total structural collapse during an earthquake. However, during life time use of the subject development, it is our opinion that some structural damage may be anticipated requiring minor to moderate structural repairs. Adequate structural design and implementation of such in construction should be strictly observed. Use of flexible life-line connections are highly recommended.

The following presents the seismic design parameters as based on the available publications as currently published by the California Geological Survey and 2016 CBC.

TABLE 3.8A.1 Seismic Design Parameters

2016 CBC Chapter 16 Paragraph/Table	2016 ASCE 7 Standard Seismic Design Parameters	Recommended Values
1613A.5.2	Site Class	D
1613.5.1	The mapped spectral accelerations at short period	S_s
1613.5.1	The mapped spectral accelerations at 1.0-second period	S_1
1613A5.3(1)	Site Class B / Seismic Coefficient, S_s	1.931 g
1613A5.3(2)	Site Class B / Seismic Coefficient, S_1	0.859g
1613A5.3(1)	Site Class D / Seismic Coefficient, F_a	1.000 g
1613A5.3(2)	Site Class D / Seismic Coefficient, F_v	1.500 g
16A-37 Equation	Spectral Response Accelerations, $S_{Ms} = F_a S_s$	1.931 g
16A-38 Equation	Spectral Response Accelerations, $S_{M1} = F_v S_1$	1.288g
16A-39 Equation	Design Spectral Response Accelerations, $S_{Ds} = 2/3 \times S_{Ms}$	1.287 g
16A-40 Equation	Design Spectral Response Accelerations, $S_{D1} = 2/3 \times S_{Ms1}$	0.859 g

TABLE 3.8A.2 Seismic Source Type

Peak Horizontal Ground Acceleration (PHGA) is based on an earthquake having a 10 percent probability of "exceedance" in a 50-year period.

Seismic Source Type / Appendix C	
Nearest Maximum Fault Magnitude	M>\=6.7
Peak Horizontal Ground Acceleration	0.641 g

4.0 Evaluations and Recommendations

4.1 General Evaluations

The professional opinions contained herein are based upon surface and subsurface explorations conducted as described, along with the necessary laboratory testing and engineering evaluations as completed in accordance with the present-day Standard of Care. Although no significant variations in soil conditions are anticipated during site preparations and grading, Soils Southwest should be notified in event the subgrade soils appear considerably different from those as described herein. It will be the subcontractor's responsibility to notify such during grading and construction.

During grading shoring and bracing, if required, shall be in accordance with the current requirements of the State of California Division of Industrial Safety and other public agencies having jurisdiction.

Based on field explorations, laboratory testing and subsequent engineering analysis, the following conclusions and recommendations are presented:

(i) No footings and/or new fills should be placed directly bearing on the compressible surface soils existing. Moderate site clearance should be expected, including, but not be limited to, discarded concrete, debris, and others.

(ii) From geotechnical viewpoint, the site is considered grossly stable for the proposed development.

(iii) With the presence of the near surface compressible soils existing, for structural support, conventional grading is suggested in form of subexcavations, scarifications and moisturization, followed by the excavated soils replacement as engineered fills compacted to 90% or better. In event, new fill soils are required, such imported fills should be placed following subgrade preparations as described.

(iv) The sub-excavation depths described in this report should be considered as "minimum". During grading localized deeper sub-excavations may be warranted as determined by soils engineer during grading.

(v) In order to minimize potential excessive differential settlements, it is recommended that structural footings should be established exclusively into engineered fills of local soils or its equivalent or better, compacted to the minimum percent compaction as described. Construction of footings and slabs straddling over cut/fill transition, should be avoided.

(vi) Structural design considerations should also include the described probability for peak ground acceleration from relatively active nearby earthquake faults. The adverse effects of ground shaking to structures can be minimized by implementation of the seismic design requirements and the design procedures as outlined in the current CBC and as described earlier in this report.

(vii) Provisions should be maintained during construction to divert incidental rainfall away from the structural pads when constructed.

(viii) It is our opinion that, if site preparations and grading are performed as per the generally accepted construction practices and as described, the proposed development will not adversely affect the stability of the site, or the properties adjacent.

4.1.1 Preparations for Structural Pads

Considering the presence of the near surface loose soils existing as described, it is our opinion that for adequate structural support, site preparations and grading should be considered in form of subexcavations of the upper compressible soils existing as described, followed by their replacement as engineered fills compacted to minimum 90%. In general, the site preparations and grading described should encompass, in minimum, the planned building foot print areas and at least 5 feet beyond. During grading subexcavation depths varying from 5 to 6 feet below the current grade surface may be anticipated. Supplemental subexcavations may be warranted to expose the underlying moist and dense natural subgrades. In general, for adequate structural support, it is our opinion that, a minimum 30-inch thick compacted fill mat blanket should be maintained below load bearing foundation bottoms. Actual subexcavation depth should be determined by the project geotechnical engineer during mass grading operations.

Since finish pad grade elevations are unknown and since no topographic or grading plans are available for review, for adequate structural bearing, the following general recommendations are supplied:

A> For the pads proposed following cuts to current grades, it is recommend that following such cuts, the cut surface should be further subexcavated to depth a minimum vertical depth equal to the planned footing embedment plus 30-inch. The site grading should also include local soils replacement as engineered fills compacted to 90% or better.

B> Within low-lying areas requiring new fill soils placement for finish grades, following removal of near surface loose and compressible soils to full depth as required to expose the underlying moist dense subgrades, site grading should include further scarification, moisturization and recompaction, followed by new engineered fill soils placement to establish the 30-inch thick compacted fill mat below foundation bottoms compacted to minimum 90%.

C> Within areas of cut/fill transition pads, if any, it is recommended that within areas requiring cuts to present grades, following such cut, the cut portions of the pad should be further subexcavated and replaced with engineered fills, the overall depth of which below foundation bottoms should be at least 30-nch. Within areas requiring fill soils to planned grade, depth of engineered fills below foundation bottoms should similarly be 30-inch as described earlier.

Foot-print areas described should be defined as the area extending from the outer edge of the planned structure, plus, either to:

(i) a distance of 5 feet, or
(ii) to the nearest property line, or
(iii) to the nearest constraint, such as existing foundations, or
(iv) as determined by soils engineer during grading and construction.

Further grading recommendations should be warranted following site topographic and grading plan review.

4.2 Structural Fills

4.2.1 Structural Fill Material

The local soils free of organic, roots, debris and rocks larger than 6-inch in diameter may be considered suitable for re-use as structural backfill.

Although no significant variations in soils conditions are anticipated, actual soils conditions may vary considerably during site preparations and grading. It will be the grading contractor's responsibility to notify Soils Southwest about subsoil variations, if any, to provide revised/updated recommendations.

Import soils, if required, should be silty sandy in nature similar to the local soils as described, or better as approved by soils engineer. In general, fill soils for structural support shall, in minimum, meet the following criteria:

Plasticity Index	<15
Expansion Index	<20

4.2.2 Structural Fills in Contact with Concrete and Steel

Representative site soils sampled from graded fills expected in contact with footings and utilities should be laboratory tested to verify presence of Chloride, Sulfate, pH and Resistivity. It is suggested that based on such chemical test results supplemental design recommendations will be required prior to concrete pour. When requested, such chemical testing will be programmed following mass grading completion.

4.3 Recommendations for Load Bearing Spread Foundations

The structures planned are expected of conventional wood frame and stucco construction with continuous wall and/or isolated spread footings founded exclusively into engineered fills of local soils or its equivalent or better, compacted to minimum 90%. From static loading conditions, assuming light loaded wood-framed structures, load bearing footings may be designed by the project structural engineer considering an allowable soil vertical bearing capacity of 1800 psf, sized to minimum and 15"x18" or 18"x24" for one, two or 3-story structures, founded exclusively into the local non-expansive graded fills of local soils compacted to minimum 90%. As described, in general, for adequate support, a minimum 30-inch thick compacted fill mat should be maintained below the load bearing foundation bottoms. Use of the Seismic Design parameters based on the 2016 CBC as discussed should be incorporated in structural design.

To minimize potential differential settlements, use of footings straddling over cut/fill transition shall be avoided. Supplemental recommendations for construction within cut and fill transition conditions will be supplied when requested.

Under static loading conditions, from geotechnical view point, footing reinforcements consisting of 2-#4 rebar placed near the top and 2#4 rebar near bottom of continuous footings, are recommended. Actual reinforcement requirements, however, should be used as supplied by the project structural engineer.

The settlements of properly designed and constructed foundations supported on engineered fills comprising of site soils or its equivalent or better, and carrying maximum anticipated vertical loadings of 3 klf and 25 kips, are expected to be within tolerable limits. Over a 40 feet span, estimated total and differential settlements, in between similarly loaded columns, are estimated to about 1 and 3/4-inch, respectively. Most of the elastic deformations are anticipated during construction. During construction, no special subgrade pre-saturation is expected other than those as generally required to maintain a moist subgrade soils conditions.

4.4 Concrete Slab-on-Grade

The prepared subgrades to receive footings should be adequate for concrete slab-on-grade placement. For normal load bearing conditions, the following is provided for reference only.

Building Slabs:

1. Suggested 3 ½" thick (net) slab thickness,
2. 2500 psi concrete with water/cement ratio of 0.64 maximum,
3. #3 rebar @ 18" o.c. on chairs, or as required by the project structural engineer.,
4. Suggested 10 mil Stego Wrap vapor barrier, sealing using Stego Wrap Tape, or equivalent,
5. Two (2) inches of sand with SE>30 over and Stego Wrap System,
6. Saw cuts per structural engineer.

Driveways:

1. 6" net (driveway) slab thickness,
2. 2500 psi concrete with water/cement ratio of 0.64 maximum,
3. Over native grade compacted to a maximum of 95%.

Flatwork:

1. 3 ½" net concrete thickness,
2. 2500 psi concrete with water/cement ratio of 0.64 maximum,
3. Over native grade compacted to a minimum 90%,
4. Tooled joints per the structural engineer.

It is recommended that, prior to concrete pour, utility trenches underlying concrete slabs and driveways should be thoroughly backfilled with sandy gravelly soils, mechanically compacted to to the minimum compaction requirements as described.

4.5 Resistance to Lateral Loads

Resistance to lateral loads can be restrained by friction acting at the base of foundation and by passive soil earth pressure. A coefficient of friction of 0.3 may be assumed with normal dead load forces for footing established on compacted fills.

An allowable "passive" lateral earth resistance of 250 pounds per square foot per foot of depth may be assumed for the sides of foundations poured against compacted fills. The maximum lateral passive earth pressure is recommended not to exceed 2500 pounds per square foot.

For the soils encountered, the following "active" lateral pressures in from of equivalent fluid density may be considered when used as level backfill

Active:	45 pcf
At Rest:	60 pcf

4.6 Shrinkage and Subsidence

It is our opinion that during grading the upper compressible silty sandy soils as described may be subjected to a volume change. Assuming a 90% relative compaction for structural fills and assuming an overexcavation and re-compaction depth as described earlier, such volume change due to shrinkage may be on the order of 15 to 20 percent. Further volume change may be expected due to supplemental shrinkage during preparation of subgrade soils. For estimation purpose, such may be approximated to about 2-inch when conventional construction equipments are used.

4.7 Construction Consideration

4.7.1 Unsupported Excavation

Based on our site review, it is our opinion that the site soils are not highly susceptible to caving. Temporary excavations up to 5 feet in depth may be made without rigorous lateral supports. Excavated surface should be 'wetted' 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.

4.7.2 Supported Excavations

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

4.8 Soil Caving

It is our opinion that the site soils may be susceptible to caving. Accordingly, it is our opinion that precautions should be made for 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.

4.9 Tentative Structural Pavement Thickness

Interior concrete driveways, when planned, should be minimum 6-inch thick (net), placed directly on local soils compacted to minimum 95%. Additional paving design recommendations will be supplied, when requested.

4.10 Retaining Wall (If proposed)

Verification of the adequacy of the existing retaining wall is not within our scope of work. Supplemental earth retaining walls, if any, should be designed based on following tentative equivalent fluid density:

Slope of Retained Material (H:V)	Equivalent Fluid Density, pcf	
	Clean Sand	Local Soil
level	30	45
2:1	42	55

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.

Use of "french-drain" behind retaining walls is recommended to minimize water pressure build-up behind retaining walls. Such should include 4" diameter perforated pvc pipes with perforations down, encased with 1 cft of crushed rock or gravel, wrapped within commercially available filter fabric. Supplemental recommendation on such will be supplied following precise grading plan review.

Backfill behind retaining wall should be compacted to a minimum 90 percent relative to 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 the minimum described. Jetting is not recommended within utility trench backfill. Within streets, upper 2 feet of the trench backfill should be compacted to 95% or better.

To prevent water migrating into street mains and laterals that may cause subsequent backfill failure, it is strongly recommended that the grades immediately behind curb-gutter should be properly prepared as recommended by civil engineer so as not to allow any long-term "ponding" from irrigation and incidental rains.

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 excavations should conform to the requirements of Cal-Osha

4.12 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.

4.13 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, use of planter boxes with sealed bottoms, should be considered.

4.14 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 lifetime use.

4.15 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 excavations should be removed and such should not be allowed on slab subgrades.

4.17 Plan Review

No detailed topographic and/or grading plan is available for review. When prepared, detailed site-specific grading and development plans should be available for to ensure applicability of the recommendations as described in this report. Following review, if conditions are observed different from those as assumed in preparing this report, revised and/or supplemental recommendations may be warranted.

4.18 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.

5.0 General Earth Work/General Grading Recommendations

Site preparations and grading should include, among others, clearance of surface vegetation, roots, numerous construction debris and other, along with over-excavation and replacement of local excavated stockpiles as structural fill compacted as recommended. Although no significant variations in soil conditions are anticipated, actual soils conditions may vary one the subgrades are exposed. In such event, It will be the contractor's responsibility to notify soils engineer for revised/updated recommendations, if warranted.

Structural Backfill:

Local soils free of debris, large rocks and organic should be considered suitable for reuse as structural 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. Additional recommendations on such will be supplied when requested.

Site Drainage:

Adequate positive drainage should be maintained away from the structural pads constructed. A 2% desirable slope for surface drainage is recommended. Planters and landscaped areas adjacent to building should be designed as such so as to minimize water infiltration into sub-soils. Adjacent to footings, use of planter areas with closed bottoms and controlled drainage, should be considered.

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 pipe should be mechanically compacted.

6.0 Supplemental 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. For adequate structural for the planned dwellings at the south, the existing pond should be thoroughly de-watered followed by removal of loose and wet soils as encountered. Removal of such should be verified and approved by the project soils engineer prior to new fill soils placement for planned pads.

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 as recommended earlier. In order to minimize potential differential settlements, no cut/fill transition conditions should be allowed within structural pad and minimum five feet beyond.

4. Utility trenches within building pad areas and beyond should be backfilled using granular material mechanically compacted to the satisfaction of the local government agency requirement, or to minimum percent compaction requirements as described in this report.

5. Compaction for structural fills shall be determined relative to the Maximum Dry Density as determined by ASTM D1557 compaction methods. All in-situ field density of compacted fill shall be determined using Sand-Cone Test (ASTM D1556) method or by using Nuclear Gauge as per the ASTM Standard D2992 test standard, or both.

6. Imported soils if required shall be clean granular non-expansive material. Imported fill should be verified by soils engineer prior to their importation to the site.

7. During grading, fill soils shall be placed in 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.

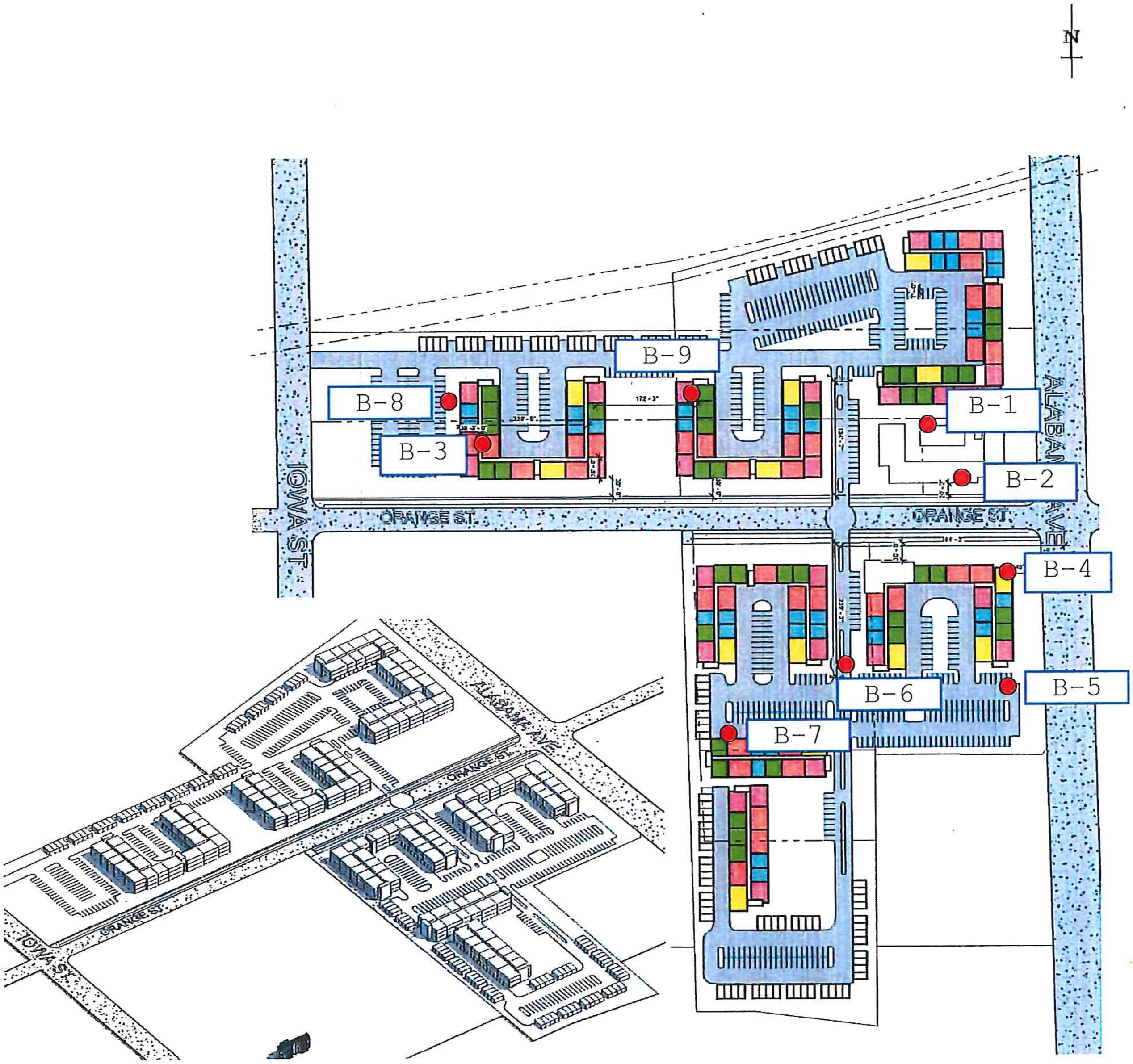
9. No jetting and/or water tampering be considered for backfill compaction for utility trenches without prior approval of the soils engineer. For such backfill, hand tampering with fill layers of 8 to 12 inches in thickness, or as approved by the soils engineer, is recommended.

10. Utility trenches at depth and cesspool and abandoned septic tank, if and when encountered 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. 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.

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

PLOT PLAN AND TEST LOCATIONS
Proposed Senior Housing Complex
NWC County Line Rd. & 5th St., Yucaipa, California
(not to scale)



Legend: ● B-1 Approximate Location of Test Borings

Plate 1

6.0 APPENDIX A

Field Explorations

Field evaluations included site reconnaissance and exploratory test borings using a drill rig supplied by Pacific Drilling. 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. Approximate test locations are shown on Plate 1.

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.

Log of Test Borings 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: SD Homes-Lux View
Job No.: 17055-F
Logged By: John F.
Boring Diam.: 6" HSA
Date: April 23, 2018

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-SM			weeds SAND - grayish light brown, silty, fine to medium with pebbles and scattered rock fragments, dry, loose - (Max Density = 127.5 pcf @ 10.0%)
8	◤ ◢						5	- color change to light brown, loose
	■	6.1	106.5	83.5	SM-ML			- color change to light brown to red brown, fine, scattered pebble, dry medium dense, tiny pinholes, scat rootlet
41	◢						10	- dense
					SM-ML		15	- color change to light brown, silty pebbles, occasional rock fragments, dry
							20	
22	◢				VS			- color change to light yellowish brown to scattered white specks, silty sand to silt sand mix, fine to medium, pebble, scattered rock fragments, medium dense
							25	
							30	- color change to gray-brown, silt sand mix, fine - color change to light gray, fine to medium, pebbles, dry, very dense
52	◢							- End of test boring @ 31.0 ft. - no bedrock - no groundwater

Groundwater: n/a
Approx. Depth of Bedrock: n/a
Datum: n/a
Elevation: n/a

Site Location
proposed apartment complex
NWC & SWC Alabama Street & Orange Avenue
Redlands, California

Plate #

◤ Bulk/Grab sample ◢ Standard penetration test ■ California sampler

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

LOG OF BORING B-2

Job No.: 17055-F
Date: April 23, 2018
Project: SD Homes-Lux View
Logged By: John F.
Boring Diam.: 6" HSA

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
					SM-ML			tilled weeds SAND - grayish light brown, silty, fine, scattered pebble, loose, dry
								- color change to reddish light brown, scattered rock fragments and1/2" rock
9	◩							
	■	6.1	102	80			5	- silty, fine, scattered pebbles, tiny pinholes
12	◩				SP-SC			- color change to red-brown with pebbles and traces of clay
	■	6.3	115.4	90.5			10	- scattered pebble, dry to damp
							15	
15	◩				SP			- color change to grayish light brown, ocassional pebbles with isolated 1-inch section of fine to medium coarse, pebbles, rock fragments, damp
								- End of test boring @ 16.0 ft. - no bedrock - no groundwater
							20	
							25	
							30	

Groundwater: n/a
Approx. Depth of Bedrock: n/a
Datum: n/a
Elevation: n/a

Site Location
proposed apartment complex
NWC & SWC Alabama Street & Orange Avenue
Redlands, California

Plate #

◸ Bulk/Grab sample ◩ Standard penetration test ■ California sampler

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

LOG OF BORING B-3

Project: SD Homes-Lux View
Job No.: 17055-F
Logged By: John F.
Boring Diam.: 6" HSA
Date: April 23, 2018

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
					SM-ML			sand, gravels, scattered cobbles
								SAND - brown, silty, fine, dry, loose
	■	4.0	96.7	75.8				- color change light brown, fine to medium coarse, scattered pebble, dry some roots
							5	
7	◪							
								- End of test boring @ 6.0 ft. - no bedrock - no groundwater
							10	
							15	
							20	
							25	
							30	

Groundwater: n/a
Approx. Depth of Bedrock: n/a
Datum: n/a
Elevation: n/a

Site Location
proposed apartment complex
NWC & SWC Alabama Street & Orange Avenue
Redlands, California

Plate #

◩ Bulk/Grab sample ◪ Standard penetration test ■ California sampler

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

LOG OF BORING B-4

Project: SD Homes-Lux View		**Job No.:**	17055-F
Logged By: John F.	**Boring Diam.:** 6" HSA	**Date:**	April 23, 2018

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
					SM-ML			weeds SAND - grayish light brown, silty, fine, loose, dry
14	◢ ■	10	114.2	89.6			5	- color change to light brown to reddish brown, silty, fine, scattered pebble, medium dense, dry - color change to orangish light brown silty, fine to medium coarse, pebble, damp
18	◢						10	- color change to yellowish light brown silty, fine, scattered pebbles and rock fragments
							15	
16	◢				VS			- silt-sand mix, color change to grayish light brown, fine to medium scattered pebble and rock fragments, dry to damp
								- End of test boring @ 16.0 ft. - no bedrock - no groundwater
							20	
							25	
							30	

Groundwater: n/a
Approx. Depth of Bedrock: n/a
Datum: n/a
Elevation: n/a

Site Location
proposed apartment complex
NWC & SWC Alabama Street & Orange Avenue
Redlands, California

Plate #

◣ Bulk/Grab sample ◢ Standard penetration test ■ California sampler

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

LOG OF BORING B-5

Project: SD Homes-Lux View
Job No.: 17055-F
Date: April 23, 2018
Logged By: John F.
Boring Diam.: 6" HSA

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
					SM-ML			weeds SAND - light brown, silty, fine, dry, loose
16	◣						5	- color change to reddish brown, fine pebble, scattered rock fragments medium dense
								- silty nodules
	■	4.9	107.5	84.3				- color change to orangish light brown, fine to medium coarse, pebbles, and fragmented rock 1/2"
					SP		10	- gravely, medium to medium coarse, pebble, rock fragments, dry
11	◢				SM-ML			- color change to yellowish light brown to light gray brown, silty, fine, occasional pebble, scattered rock fragments, dry
							15	- End of test boring @ 11.0 ft. - no bedrock - no groundwater
							20	
							25	
							30	

Groundwater: n/a
Approx. Depth of Bedrock: n/a
Datum: n/a
Elevation: n/a

Site Location
proposed apartment complex
NWC & SWC Alabama Street & Orange Avenue
Redlands, California

Plate #

◣ Bulk/Grab sample ◢ Standard penetration test ■ California sampler

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

LOG OF BORING B-6

Project: SD Homes-Lux View
Job No.: 17055-F
Logged By: John F.
Boring Diam.: 6" HSA
Date: April 23, 2018

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
					SM-ML			weeds
								SAND - light brown, silty, fine, scattered pebbles, rock fragments, and rock 1/2"-1"
							5	- color change to gray-brown, silty, fine, damp, very loose
4	◩							- very loose
							10	
					SM		15	- color change to reddish gray brown, silty, fine to medium, pebbles, rock fragments, damp
6	◩				SP			- color change to yellowish light brown traces of silt, fine to medium coarse pebble, rock fragments, scattered rock 1", dry, loose
							20	
							25	
17	◩				SM-ML			- color change to gray-brown, silty, fine, damp to moist, medium dense with pulvarized rock
								- End of test boring @ 26 ft. - no bedrock - no groundwater
							30	

Groundwater: n/a
Approx. Depth of Bedrock: n/a
Datum: n/a
Elevation: n/a

Site Location
proposed apartment complex
NWC & SWC Alabama Street & Orange Avenue
Redlands, California

Plate #

◸ Bulk/Grab sample ◩ Standard penetration test ■ California sampler

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

LOG OF BORING B-7

Project: SD Homes-Lux View

Job No.: 17055-F

Logged By: John F.

Boring Diam.: 6" HSA

Date: April 23, 2018

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
					FILL	▨		weeds, scattered debris
						▨		SAND - grayish light brown, silty, fine, scattered pebble, dry, loose
	■	4.7	105.3	82.4		▨	5	- dry with scattered debris (string) fine to medium coarse, pebbles and fragmented rock 1/4"
8	◩				SP-SM	⁙		- slightly silty, traces of clay, fine to medium, pebble, occasional rock fragment, damp, loose
						⁙	10	
						⁙	15	
10	◩				VS	⁙		- color change to light yellowish brown silt-sand mix, scattered pebbles and rock fragments, damp
								- End of test boring @ 16.0 ft. - no bedrock - no groundwater
							20	
							25	
							30	

Groundwater: n/a
Approx. Depth of Bedrock: n/a
Datum: n/a
Elevation: n/a

Site Location
proposed apartment complex
NWC & SWC Alabama Street & Orange Avenue
Redlands, California

Plate #

◪ Bulk/Grab sample
◩ Standard penetration test
■ California sampler

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

LOG OF BORING B-8

Project: SD Homes-Lux View
Job No.: 17055-F
Logged By: John F.
Boring Diam.: 6" HSA
Date: April 23, 2018

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
					SM			weeds, scattered debris
								SAND - light brown, silty, fine, very loose
								- fine to medium with scattered pebbles
							5	- color change to grayish brown, silty, fine, scattered pebbles, very loose
4	◩							
	■	9.6	116.2	91.2	SM-ML			- color change to brown, silty, fine occasional pebble and rock fragments, damp, loose
					SP		10	- color change to reddish brown to gray brown, silty, traces of clay, fine to medium, pebbles, scattered rock fragments, damp, loose
6	◩							
							15	
								- silt nodules
					SM-ML		20	- silty, fine, pebbles, occasional rock fragments and scattered 1/2" to 1" rock
14	◩				VS			- color change to yellowish light brown, silt-sand mix, fine, damp, medium dense
								- End of test boring @ 21.0 ft. - no bedrock - no groundwater
							25	
							30	

Groundwater: n/a
Approx. Depth of Bedrock: n/a
Datum: n/a
Elevation: n/a

Site Location
proposed apartment complex
NWC & SWC Alabama Street & Orange Avenue
Redlands, California

Plate #

◪ Bulk/Grab sample
◩ Standard penetration test
■ California sampler

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

LOG OF BORING B-9

Project: SD Homes-Lux View
Job No.: 17055-F
Logged By: John F.
Boring Diam.: 6" HSA
Date: April 23, 2018

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
					SM-ML			weeds
								SAND - light brown, silty, fine, scattered pebbles and rock fragments, dry, loose
							5	- color change to light gray, occasional pebble, dry, loose
6	◩							- color change to light brown, damp, loose
					VS		10	- color change to light gray brown, silt-sand mix, fine, dry, very loose
3	◩							- fine to medium, pebbles, dry to damp very loose
								- End of test boring @ 11.0 ft. - no bedrock - no groundwater
							15	
							20	
							25	
							30	

Groundwater: n/a
Approx. Depth of Bedrock: n/a
Datum: n/a
Elevation: n/a

Site Location
proposed apartment complex
NWC & SWC Alabama Street & Orange Avenue
Redlands, California

Plate #

◸ Bulk/Grab sample
◩ Standard penetration test
■ California sampler

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
▒	Poorly graded sand with silt
▥	Poorly graded silty fine sand
▦	Variable sand and silt mix
▧	Poorly graded sand with clay
░	Poorly graded sand
▤	Silty sand
▩	Fill
Soil Samplers	
◥	Bulk/Grab sample
◤	Standard penetration test
■	California sampler

Notes:

1. Exploratory borings were drilled on April 23, 2018 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.

7.0 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.

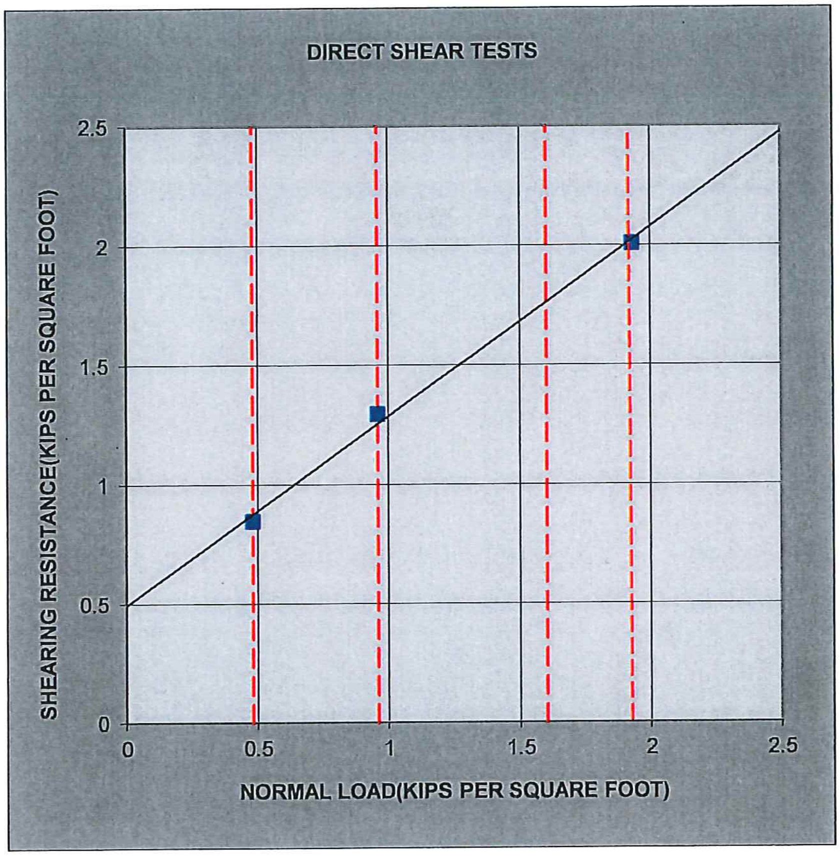
Laboratory Test Results

A. Table I: In-Situ Moisture-Density Determination (ASTM D2937),

Test Boring No.	Sample Depth, ft.	Dry Density, pcf.	Moisture Content, %
1	8.0	106.5	6.1
2	5.0	102.0	6.1
2	10.0	115.4	6.3
3	3.0	96.7	4.0
4	5.0	114.2	10.1
5	7.0	107.5	4.9
7	4.0	105.3	4.7
8	8.0	116.2	9.6

B. Table II: Max. Density/Optimum Moisture Content (ASTM D1557)

Sample Location @ depth, ft.	Max. Dry Density, pcf	Optimum Moisture (%)
B-1 @ 3-5 ft. Sand: light brown, silty, fine to medium with occasional fragmented ¾" rock	127.5	10.0

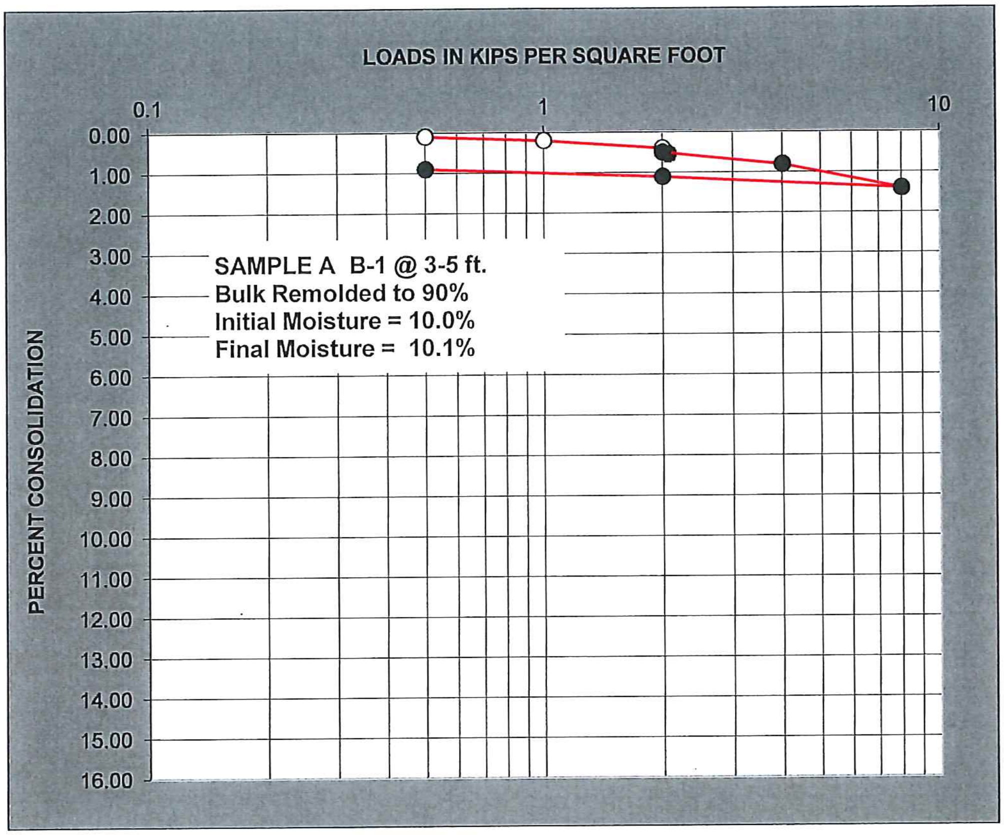


SYMBOL	LOCATION	DEPTH (FT)	TEST CONDITION	COHESION (psf)	FRICTION (degree)
■	B-1	3 to 5	Remolded to 90%	495.00	38.36

Proposed Apartment Complex and Clubhouse NWC & SWC Orange Avenue & Alabama St. Redlands, California	PROJECT NO.	17055-F
	PLATE	B-1

SOILS SOUTHWEST, INC.
Consulting Foundation Engineers

CONSOLIDATION TESTS

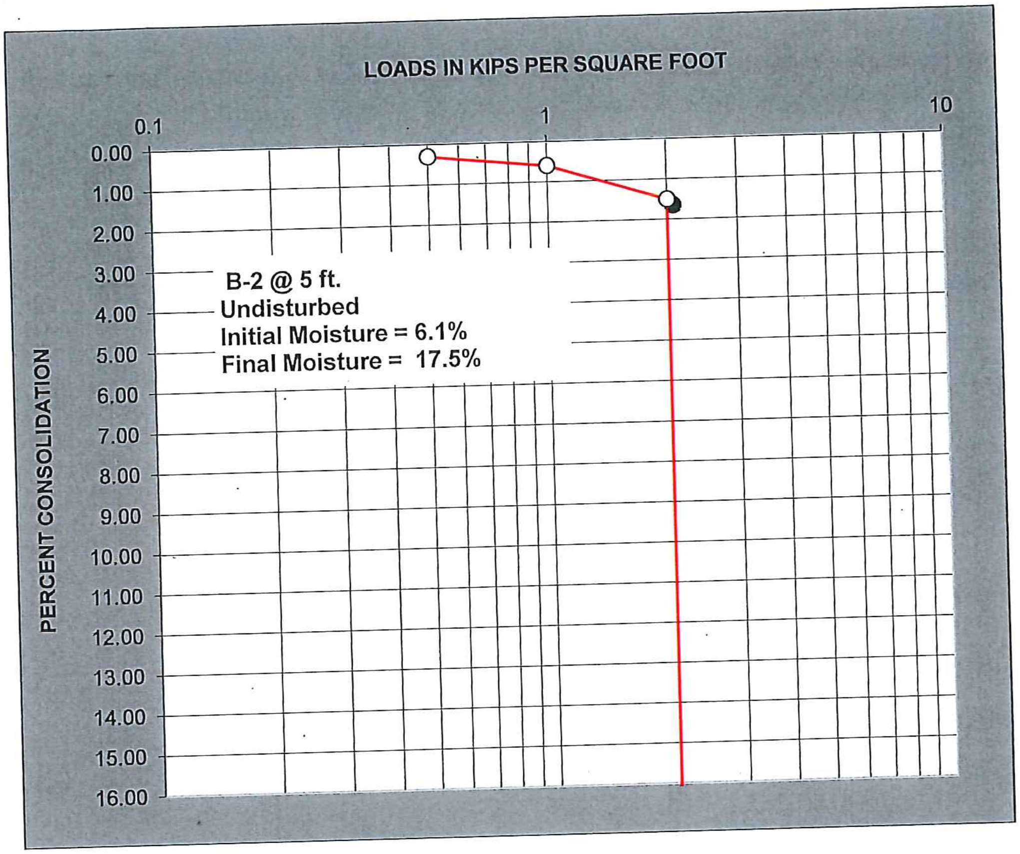


● **WATER PERMITTED TO CONTACT SAMPLE**

PROJECT	Proposed Apartment Complex & Clubhouse NWC & SWC Orange Ave. & Alabama St. Redlands			
PROJECT NO.	17055-F	PLATE	B-2	

SOILS SOUTHWEST INC.
Consulting Foundation Engineers

CONSOLIDATION TESTS



B-2 @ 5 ft.
Undisturbed
Initial Moisture = 6.1%
Final Moisture = 17.5%

● **WATER PERMITTED TO CONTACT SAMPLE**

PROJECT	Proposed Apartment Complex & Clubhouse NWC & SWC Orange Ave. & Alabama St. Redlands		
PROJECT NO.	17055-F	PLATE	B-2-1

SOILS SOUTHWEST INC.
Consulting Foundation Engineers

APPENDIX C

Supplemental Seismic Design Parameters

CALIFORNIA DIVISION OF MINES AND GEOLOGY
THOMAS E. GAY JR., ACTING STATE GEOLOGIST

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF CONSERVATION

REDLANDS QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)

TOPOGRAPHIC BASE BY U.S. GEOLOGICAL SURVEY 1967

SCALE 1:24,000

CONTOUR INTERVAL 20 FEET
DASHED LINES REPRESENT 10 FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

REFERENCES USED TO COMPILE FAULT DATA

Redlands Quadrangle

Dibblee, T.W., Jr., 1974, Geologic map of the Redlands quadrangle, California, U.S. Geological Survey, open-file map
Hope, R.A., 1969, Map showing recently active breaks along the San Andreas and related faults between Cajon Pass and the Salton Sea, U.S. Geological Survey open-file map
Sharp, R.V., 1972, Map showing recently active breaks along the San Jacinto fault zone between the San Bernardino area and Borrego Valley, California: U.S. Geological Survey, Miscellaneous Geologic Investigations Map, I-675

MAP EXPLANATION

Potentially Active Faults

1906 C — 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

REDLANDS QUADRANGLE

REVISED OFFICIAL MAP

Effective: January 1, 1977

T. E. Gay, Acting State Geologist

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

State of California
Department of Conservation

Ground Motion Interpolator (2008)

Longitude: -117.209867

Latitude: 34.051937

VS30: 270 (180-1050 m/sec)

Return Period:

2% in 50 years 10% in 50 years

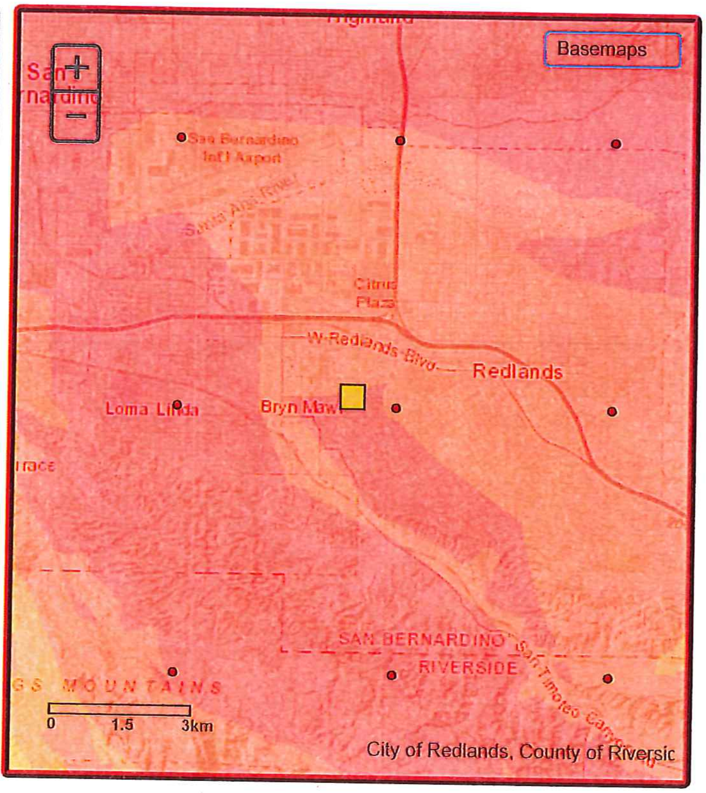
Spectral Acceleration:

PGA 0.2 second SA 1.0 second SA

Submit

Inputs:	**Result:**
-117.209867, 34.051937 vs30: 270 m/sec 10% in 50 years PGA	0.641 g

Information and Disclaimer



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USGS Design Maps Summary Report

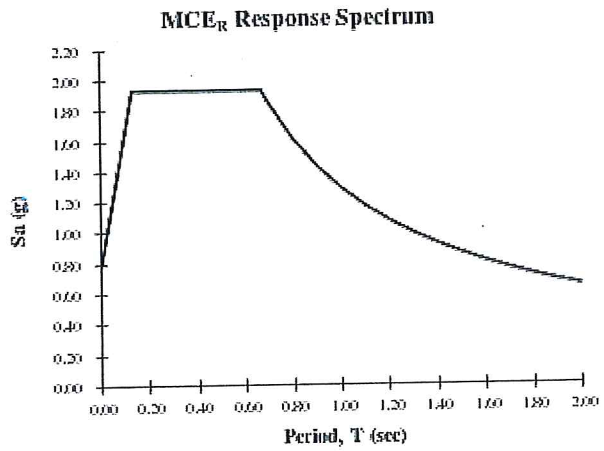
User–Specified Input

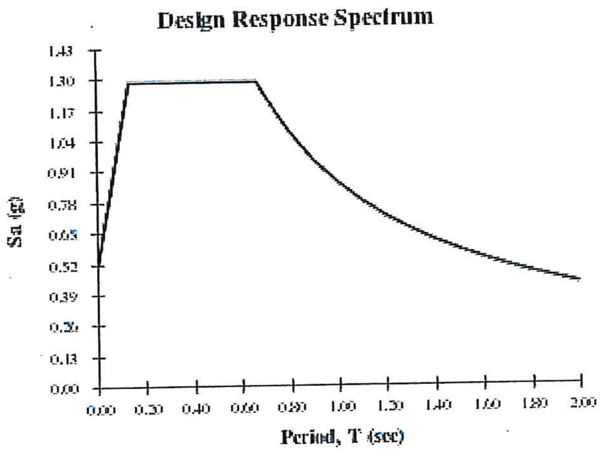
Report Title	SD HomesLuxView_Orange&Alabama Redlands,CA Thu April 19, 2018 18:54:26 UTC
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	34.05194°N, 117.20987°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	I/II/III

USGS–Provided Output

$S_S =$ 1.931 g	$S_{MS} =$ 1.931 g	$S_{DS} =$ 1.287 g
$S_1 =$ 0.859 g	$S_{M1} =$ 1.288 g	$S_{D1} =$ 0.859 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





For PGA$_M$, T$_L$, C$_{RS}$, and C$_{R1}$ values, please view the detailed report.

USGS Design Maps Detailed Report

ASCE 7-10 Standard (34.05194°N, 117.20987°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1] $S_S = 1.931$ g

From Figure 22-2 [2] $S_1 = 0.859$ g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ **or** $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index $PI > 20$, • Moisture content $w \geq 40\%$, and • Undrained shear strength $\bar{s}_u < 500$ psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient F_a

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at Short Period				
	$S_S \leq 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = D and S_S = 1.931 g, F_a = 1.000

Table 11.4–2: Site Coefficient F_v

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at 1–s Period				
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.859 g, F_v = 1.500

Equation (11.4-1): $S_{MS} = F_aS_S = 1.000 \times 1.931 = 1.931$ g

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Equation (11.4-2): $S_{M1} = F_vS_1 = 1.500 \times 0.859 = 1.288$ g

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Section 11.4.4 — Design Spectral Acceleration Parameters

Equation (11.4-3): $S_{DS} = ⅔\ S_{MS} = ⅔ \times 1.931 = 1.287$ g

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Equation (11.4-4): $S_{D1} = ⅔\ S_{M1} = ⅔ \times 1.288 = 0.859$ g

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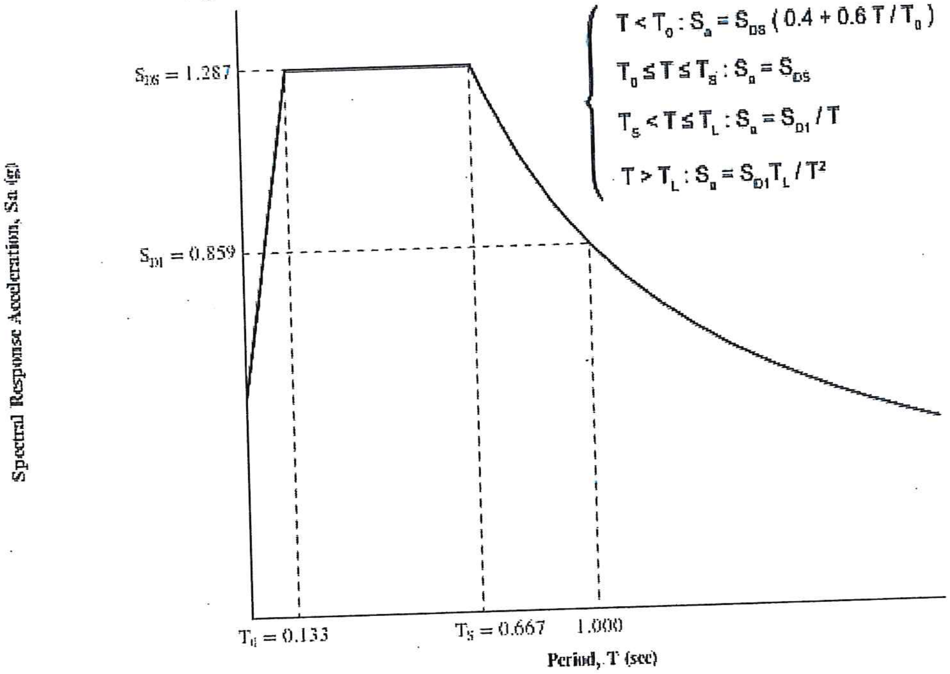
Section 11.4.5 — Design Response Spectrum

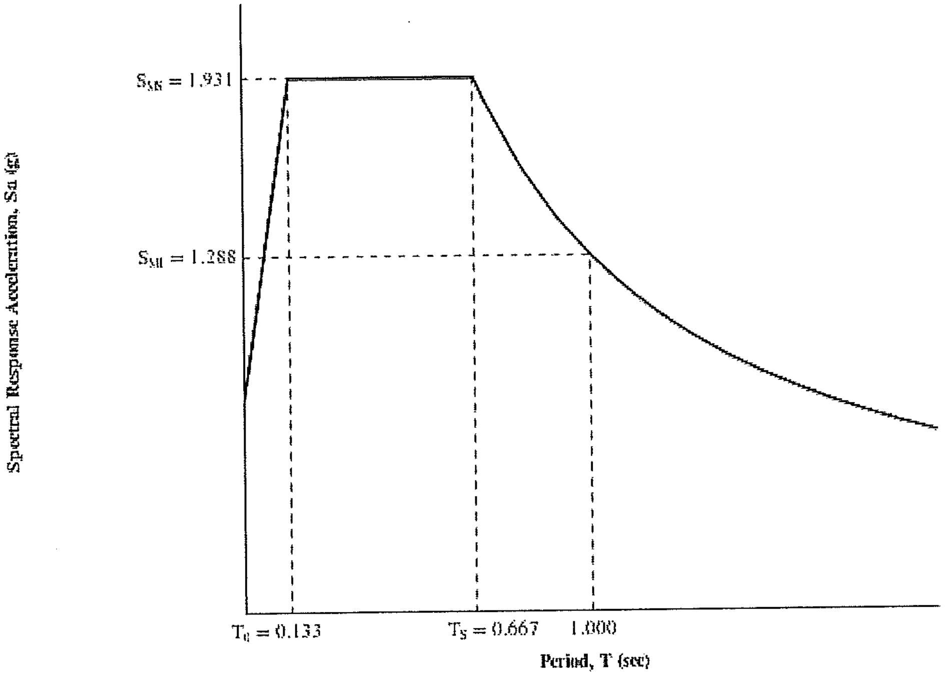
From Figure 22-12[3] $T_L = 8$ seconds

Figure 11.4-1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE$_R$) Response Spectrum

The MCE$_R$ Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.751

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.000 \times 0.751 = 0.751$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	$\boxed{1.0}$
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.751 g, F_{PGA} = 1.000

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 1.028

From Figure 22-18 [6] C_{R1} = 0.986

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	**RISK CATEGORY**		
	I or II	**III**	**IV**
$S_{DS} < 0.167g$	A	A	A
$0.167g \leq S_{DS} < 0.33g$	B	B	C
$0.33g \leq S_{DS} < 0.50g$	C	C	D
$0.50g \leq S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 1.287 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	**RISK CATEGORY**		
	I or II	**III**	**IV**
$S_{D1} < 0.067g$	A	A	A
$0.067g \leq S_{D1} < 0.133g$	B	B	C
$0.133g \leq S_{D1} < 0.20g$	C	C	D
$0.20g \leq S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.859 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = E

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

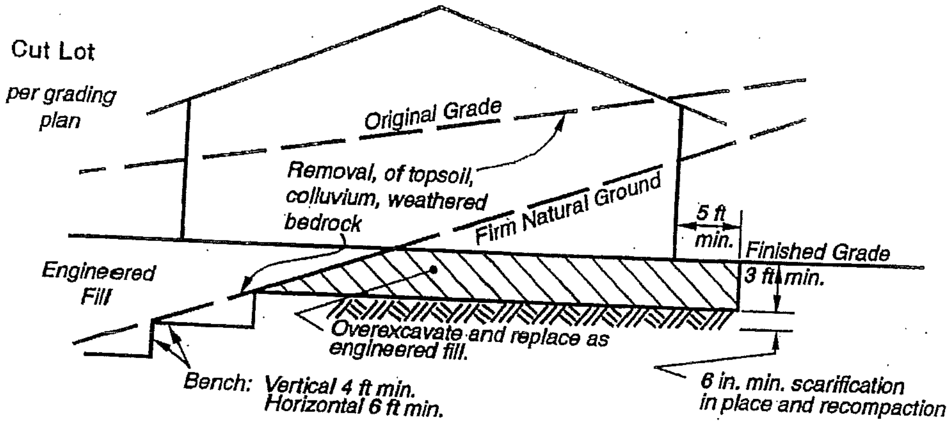
1. *Figure 22-1*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

APPENDIX D

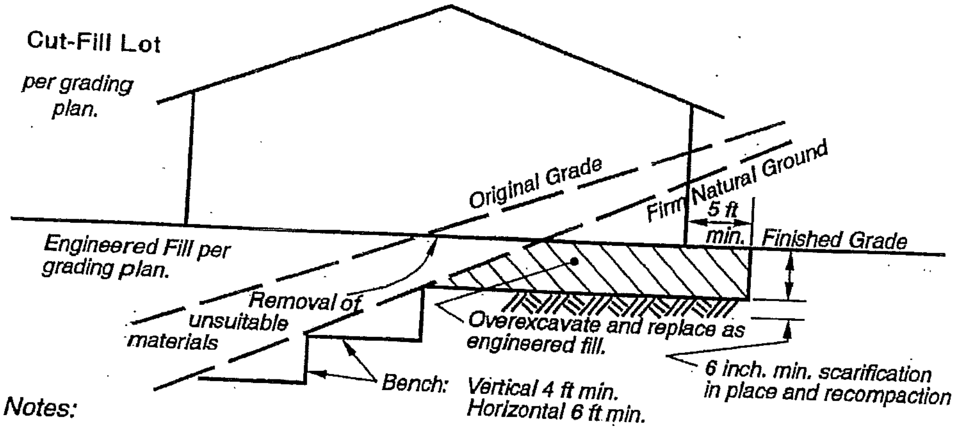
Transition Pad Construction

TRANSITION LOT OVEREXCAVATION

Cut Lot



Cut-Fill Lot



Notes:

1 - Topsoil, colluvium, weathered bedrock and otherwise unsuitable materials should be removed to firm natural ground as identified by the geotechnical engineer.

2 - The minimum depth of overexcavation should be considered subject to review by the geotechnical engineer. Steeper transitions may require deeper overexcavation.

3 - The lateral extent of overexcavation should be 5 feet minimum, but may include the entire lot as recommended by the geotechnical engineer.

4 - The contractor should notify the geotechnical engineer in advance of achieving final grades (i.e. within 5 ft) in order to evaluate overexcavation recommendations. Additional staking may be requested to aid in the evaluation of overexcavations.

STANDARD DETAIL NO. 6

PROFESSIONAL LIMITATIONS

It should be noted that due to recent rains, the site surface experienced over saturated soils conditions thereby limiting drilling rig operations and soils sampling. Consequently, only two exploratory test borings were made. Supplemental test explorations will be conducted if and, when requested.

The preliminary 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 tentative conclusions and professional advice included herein. The recommendations and opinions supplied are exclusively for the project feasibility purpose evaluations. Further detailed recommendations may be warranted following final grading, topographic and development plan review.

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 Project Soils Engineer must evaluate the changed conditions, 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 design engineers. Appropriate recommendations should be incorporated into structural plans following additional investigations as described earlier.

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 the geotechnical representative is an 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 required tests, observations and consultation by the geotechnical consultant during construction should include, but not are limited to:

a. Review of the final grading and development plans, when prepared,
b. Continuous observation and testing during site preparation and grading, and placement of engineered fill,
c. Observation and inspection of footing trenching prior to steel and concrete placement, and
d. Consultations as required during construction, or when requested.