SOILS SOUTHWEST, INC.
SOILS, MATERIALS AND ENVIRONMENTAL ENGINEERING CONSULTANTS

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Report of Geotechnical Investigations

Proposed 4-Story, 146-Unit, "The Grand" Apartment Complex
200-206 W. Redlands Boulevard
Redlands, CA
APN: 0169-281-30&31

Project No. 19034-F

May 30, 2022

Prepared for:
Vantage One Real Estate Investment IV, LLC
4 Corporate Plaza Suite 210
Newport Beach, CA 92660

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Established 1984

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Vantage One Real Estate Investment IV, LLC
4 Corporate Plaza Suite 210
Newport Beach, CA 92660

Attention: Mr. Tom Robinson

Subject: **Report of Geotechnical Investigations**
Proposed 4-story,146-Unit, The Grand, Apartment Complex
200-206 W. Redlands Boulevard
Redlands, CA 92660
APN: 0169-281-30 & 31

Reference: Architectural Developmental Plan Prepared by IDEArch, Inc.

Gentlemen,

Presented herewith is the Report of Geotechnical Investigations conducted for the site of the proposed 146-unit apartment complex to be located at 200-206 W. Redlands Boulevard, City of Redlands, California. In absence of precise grading plan, recommendations included should be considered as "preliminary. Revised and/or updated recommendations may be warranted following the detailed grading/development plan review.

Based on the project conceptual plan review, it is understood that, among others, the planned development will include a 146-unit, 4-story apartment complex with subterranean parking. Additional street grade parking is also proposed, along with a swimming pool, pool-house and other rental dwelling units. Use of concrete framed construction is expected, along with load bearing supports in form of isolated concrete spread footings, conventional spread wall foundations, isolated piles or by load bearing systems. Following site clearance moderate site preparations and grading should be anticipated for the development planned.

Based on the test explorations completed, it is our opinion that the site soils encountered primarily consist of near grade low to medium dense, compressible fine to medium coarse silty sand with rock fragments and minor rocks, overlying deposits of medium dense to dense, medium to coarse gravelly sands with pebbles and gavels to the maximum 31 feet depth explored. No shallow depth ground water is encountered.

Based on review of the Redlands Quadrangle Special Studies Zone mapping published by the California Division of Mines and Geology (DMG), it our opinion that the site under study is not situated within an A-P Special Study Zone thereby requiring no further geologic evaluations.

Review of the California Division of Mines and Geology 1974 Redlands Quadrangle Special Studies Zone mapping, it is understood that the prevailing depth to groundwater is at about 175 to 200 feet below grade. Accordingly, with the shallow depth groundwater a depth in excess of 50 feet below grade, based on review of the Special Publication SP 117, published by the State DMG, it is our opinion that the potential for seismically induced soils liquefaction should be considered "remote".

This report has been substantiated by subsurface explorations and mathematical analyses made in accordance with the generally accepted engineering principles, including those field and laboratory testing considered necessary in the circumstances. We offer no other warranty, express or implied.

Respectfully submitted,
Soils Southwest, Inc.

Moloy Gupta, RCE 31708

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STATE OF CALIFORNIA

Patricia Partas, P.E. (WA), PMP

John Flippin
Project Coordinator

1.0 Introduction

Presented herewith is the Report of Geotechnical Investigations conducted for the site of the proposed 4-story, 146-unit apartment complex to be constructed at 200-206 W. Redlands Boulevard, Redlands, California. The recommendations included should be considered as "preliminary", subject to revisions following detailed development plan review.

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 site preparations and grading, foundation design, slab-on-grade, retaining walls, paving, parking, utility trench excavations and backfill, and inspection and testing during construction. Being beyond scope of work no site-specific geologic evaluations are included and none such should be warranted for the site under study.

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

It should be noted that the recommendations supplied should be considered valid and applicable when the following conditions, in minimum, are fulfilled:

i. Detailed grading and development plan review when supplied,
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 trenches 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

Based on the architectural site plans, and the limited project information supplied, it is understood that the subject development will accommodate a 4-story structure with subterranean and on-grade auto parking.

Construction of concrete framed structure along with CMU or concrete block basement retaining structure, with concrete slabs-on-grade for auto parking. Additional street grade construction is proposed to accommodate over-flow auto parking, along with a swimming pool, pool house and some of the rental units proposed. For initial design, structural loadings of 40 kips and 4 klf for isolated column and conventional spread wall foundations, respectively are assumed for the proposed described development.

1.2 Site Description

The area of the planned development is currently occupied by a one-story furniture store on grade along with asphalt paving and parking and with scattered numerous matured trees and landscaping. In general, the site is bounded by an easement, a cinema, and other commercial developments on the north, by Redlands Boulevard on the south, by Third Street on the east, and by North Eureka Street on the west.

Generally sloping in nature, surface water is estimated to flow from the east towards the west. Except for the existing retail furniture store-structure, on grade asphalt concrete parking paving, and landscape with scattered mature trees and vegetation, no other significant features are noted.

2.0 Scope of Work

Considering the near level grade surface, no geologic investigation is prepared and one such should be warranted. A geologic evaluation report will be supplied, upon request.

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

- **Field Explorations**

  Test explorations include three (3) exploratory borings using a Hollow-Stem Auger (HSA) drill-rig equipped for undisturbed soils sampling and Standard Penetration Test (SPT) blow-counts. Additional one hand auger boring is also included within the areas considered inaccessible to drilling rig. The maximum exploratory test depth is limited to about 31 feet below the grade surface. Approximate test boring locations are shown on the attached Plate A.

  During excavations, the soils encountered were continuously logged, bulk and undisturbed samples were procured, and Standard Penetration Test (SPT) blow-counts were recorded at frequent intervals. Collected samples were subsequently transferred to our laboratory for necessary testing. Descriptions of the soils encountered are shown on the attached Log of Test Boring.

- **Laboratory Testing**

  Representative samples on the selected bulk and undisturbed soils samples were tested in laboratory to aid in the soils classification and to evaluate relevant engineering properties pertaining to the project information supplied. The laboratory testing, among others, include the following performed in accordance with the ASTM Test Standards described:

  - In-situ moisture contents and dry density (ASTM Standard D2216),
  - Maximum dry Density and Optimum Moisture Content (ASTM Standard D1557),
  - Direct Shear (ASTM Standard D3080),
  - Soil consolidation (ASTM Standard D2435), and
  - Soil Grainsize Analysis (ASTM Standard D422-63).

- Based on the field investigations, and necessary laboratory testing completed, engineering analyses and evaluations are made on which to base our preliminary recommendations for foundation design, concrete slab-on-grade, paving and parking, retaining wall, utility trench backfill, site preparations and grading, and monitoring during construction.

The recommendations supplied should be considered "tentative" and subject to revision and/or upgrading following construction details review.

3. Site Characterization

3.1 Surface and Subsurface Conditions:

The area of the planned development is currently occupied by a one-story retail structure with asphalt paving/parking along with numerous matured trees and planters. It is understood that the existing structure will be demolished and removed to accommodate the development proposed.

Based on the test explorations conducted at the locations and to the depths as described it is our opinion that the near grade soils existing primarily consist of medium dense, compressible, and collapsible soils of silty sand considered inadequate for load bearing support without excessive potentials for differential settlements.

Considering the historical shallow depth ground water at a depth in excess of 50 feet, based on the Special Publication SP 117 published by the state of California DMG, it is our opinion that the site should be considered non-susceptible to potentials for soils liquefaction in event of a strong motion earthquake.

Basement Parking: Basement parking is assumed at about 8 feet to 10 feet below the current adjacent street grade. The parking proposed is expected of conventional concrete flooring, along with vertical retaining wall. Considering the compressible/collapsible soils existing at depth as described, it is our opinion that the proposed basement parking concrete flooring should not be installed bearing directly on the basement grade once excavated.

In general, to minimize potential for differential settlements, structural footings, and load concrete garage slab-on-grade should be established bearing on a 2-feet-thick engineered fill mat blanket of local soils compacted 95% or better of the soils' Maximum Dry Density as determined by the ASTM Test Method D1557.

For conventional auto traffic, the 5-inch-thick basement flooring described should be reinforced with #5 rebar at 24-inches o/c. Actual parking floor thickness and reinforcing requirements etc. should be determined by the project structural engineer using soils' Subgrade Reaction, k_c = 200 kcf.

Basement Parking Retaining Wall

Retaining structure of about 8 to 10 feet is assumed in association with the basement parking proposed. Under static loading conditions, retaining structure may be designed by the project structural engineer using the following equivalent active pressures in the form of fluid density:

Slope Surface of Retained Material (h:v)	Equivalent Fluid Density (pcf) Imported Clean Sand	Local Site Soil
Level	30	45
2:1	35	45

Retaining wall foundations design may be based on soil vertical bearing capacity of 2000 psf for the regraded soils underneath wall foundations compacted to minimum 95%.

The recommended lateral pressures do not include any surface load surcharge. Use of heavy equipment near retaining wall may develop lateral pressure in excess of the parameters described above. Installation of "French-drain" behind retaining walls is recommended to minimize water pressure build-up.

Backfill behind the retaining wall should be compacted to a minimum 90% relative laboratory determined Maximum Dry Density as determined by the ASTM D1557 test method. Flooding and/or jetting behind wall should not be permitted. Local sandy soils may be used as wall backfill. Supplemental may be warranted following detailed development plan review.

Under seismic loading conditions, the retaining wall may be designed using the following design parameters:

Sin $\Phi = 30^0$,
Soil density, ¥ = 120 pcf,
Static Active pressure coefficient $K_a = 0.33$,
P_a = Active Earth pressure resultant ½ ¥ H^2K_a = 1980 lbs/ft run acting at 1/3 H from bottom.
Seismic Design Coefficient, K_h= 25H = 25x10' = 250 psf,
where H=10' wall height.

Supplemental design recommendations may be warranted following development details review.

In minimum the retaining wall stability should be checked against (i) sliding, (ii) overturing, (iii) soil vertical bearing capacity and others as considered necessary by the design professional.

Should the project structural engineer determine that more stringent design criteria should be required, then the above recommendations should be superseded to the satisfactions of the project design professionals.

Local soils free of organic, debris or rocks larger than 6–inch in overall diameter should be considered suitable for re-use as structural backfills.

Laboratory shear tests conducted on the upper bulk soil sample remolded to higher densities indicate moderate shear strength under increased moisture conditions. Results of the laboratory shear tests are provided in Appendix B of this report.

Consolidation tests conducted on the upper soils remolded to 90% indicate low potential for compressibility under anticipated structural loadings. Results of the laboratory determined soils consolidation potentials are shown on the plates in Appendix B of this report.

3.1.1 Compressible and Collapsible Soils

Based on the laboratory testing, it is our opinion that the near grade soils existing as encountered should be considered compressible and hydro-collapsible in nature, and thus are considered susceptible to excessive settlements under structural loadings. For adequate support, it is our opinion that the load bearing soils should be reworked in form of sub-excavations and their replacement as engineered fills compacted to minimum 95%. In general, the sub-excavation described should be of sufficient depth so as to maintain 24-inch-thick compacted fill mat blanket underneath footings. Actual excavation depth should be verified by the project soils engineer during grading.

The site preparations underneath load bearing foundations should include the compacted fill mat blanket as described, encompassing at a minimum, the planned footprint areas and minimum 5 feet beyond. Where restricted due to existing development, the lateral extent of load bearing footings may be compensated by using deepened foundations.

3.1.2 Expansive Soils

The near surface sandy gravely soils encountered are considered "very low" in expansion potential Expansion Index, EI, less than 20. It is recommended that following mass grading completion, the near grade soils should be further evaluated for expansion potential, based on which supplemental recommendations should be warranted.

3.2 Excavatibility

It is our opinion that the grading required for the project may be accomplished using conventional heavy-duty construction equipment. No jackhammering or use of other explosive devise should be warranted.

3.3 Groundwater

No groundwater was not encountered within the maximum 31 feet depth explored. The current groundwater and historical shallowest groundwater level as recorded within the past fifteen years are described in the following groundwater table.

The following table describes the historical and the current groundwater level as recorded in the nearest well as listed 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 2018
Well Number	01S/03W-28J002S New York Street
Well Monitoring Agency	City of Redlands
Well Location: Township/Range/Section	T01S-R03W-Section 28
Well Elevation:	1,310.0
Current Depth to Water (Measured in feet)	187
Current Date Water was Measured	November 1, 2021
Depth to Water (Measured in feet) (Shallowest)	112
Date Water was Measured (Shallowest)	April 1, 2000

Fluctuations in groundwater levels, however, can occur due to seasonal variations in the amount of rainfall, runoff, altered natural drainage paths, and other factors not evident at the time the test borings completed. Accordingly, for the planned development, it is our opinion that provisions should be maintained to dispose incidental surface runoff away from the individual structural pads, once constructed

3.4 Subsurface Variations

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

3.5 Soil Corrosivity Analyses

Since soils chemical compositions are expected to change considerably during mass grading, no soils chemical analyses are currently programmed. It is recommended, that immediately following mass grading completion, the representative soils anticipated directly in contact with footings, concrete slab-on-grade and buried metal utilities should be laboratory tested to determine pH, sulfate, chloride, and resistivity. Results of such testing will be supplied upon request.

3.6 Faulting and Seismicity

3.6.1 Direct or Primary Seismic Hazards

Surface ground rupture along with active fault zones and ground shaking represent primary or direct seismic hazards to structures. In absence of known earthquake faults passing through or towards the project area, the subject site should be considered not situated within an AP Special Studies Zone.

According to the 2019 CBC, the site is considered within Seismic Zone 4, as a result it is likely that during the life expectancy of the proposed construction, "moderate" ground shaking may have adverse effects on the planned development.

3.6.2 Induced or Secondary Seismic Hazards

In addition to ground shaking, effects of seismic activity may include surface fault rupture, soil liquefaction, and differential settlement, ground lurching, landslides, lateral spreading, and earthquake induced flooding. Opinions regarding site specific secondary effects are explained as follows.

3.6.2.1 Surface Fault Rupture

Based on review of the CGS available publications, it is understood that no major fault crosses through or extends towards the site. The potential for surface rupture resulting from nearby fault movement is not known for certainty but is considered "low" considering to the distance of the site to the known nearest San Jacinto fault situated at about 4.08 miles away.

3.6.2.2 Flooding

Flooding hazards include tsunamis (seismic sea waves), seiches, and failure of manmade reservoirs, tanks, and aqueducts. The potential for these hazards is considered remote due to the inland site location and absence of any known nearby bodies of water.

3.6.2.3 Land-Sliding

Seismically induced landslides and other slope failures are common occurrences during or soon after an earthquake. Considering the site and its adjacent being relatively flat, it is our opinion that potential for seismically induced landslides should be considered "remote".

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. In absence of obvious presence of such, it is our opinion that the potential for lateral spreading should be considered remote.

3.6.2.5 Settlement and Subsidence

Considering the presence of medium to dense gravely fine to coarse soils with high SPT blow counts encountered at depth as described, it is our opinion that potential/possibility for ground settlement of the existing grade surface due to strong motion seismically induced ground shaking should be considered remote.

3.6.2.6 Liquefaction

Liquefaction is caused by build-up of excess hydrostatic pressure 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 recorded relatively high SPT blow counts as recorded during test explorations, along with the absence of shallow depth ground water within 50 feet below grade, based on the California DMG Special Publication SP117, it is our opinion that the site should be considered non-susceptible to seismically induced potentials for soils liquefaction.

3.7 Seismically Induced Settlement and Subsidence

The site is situated at about 4.08 miles from the San Jacinto fault capable of generating an earthquake magnitude, M of 7.4 and Peak Ground Acceleration, PGA of 0.632g. Considering the proximity of the earthquake fault as described, along with the presence of dense subgrades with high SPT blow counts as recorded, seismically induced ground settlements and subsidence are expected within ground settlement of 1-inch and ½-inch, respectively. Although not expected, further evaluations for such will be conducted upon request.

3.8 Seismic Design Coefficients

Using site coordinates of 34.057742°N, and -117.185322°W, proximity of the closest San Jacinto fault is estimated to about 4.08 miles away. For foundation and structural design, the following seismic parameters are suggested based on the current 2019 CBC.

The recommended seismic design parameters are based upon the USGS ASCE 7-Hazard Reports Parameters and the California Geologic Survey: PSHA Ground Motion Interpolator Supplemental seismic parameters are provided in Appendix C of this report. For foundation and structural design, the following presents the seismic design parameters as based on the available publications as currently published by the California Geological Survey and 2019 CBC.

TABLE 3.8.1 Seismic Source Type

Based on California Geological Survey-Probabilistic Seismic Hazard Assessment Peak Horizontal Ground Acceleration (PGA) having a 10% probability of exceedence in a 50-year period is described as below:

Seismic Source Type / Appendix C	
Nearest Maximum Fault Magnitude	M>\=7.4
Peak Horizontal Ground Acceleration, PGA	0.632g

In design, vertical acceleration may be assumed to about 1/3 to 2/3 of the estimated PGA as described.

TABLE 3.8.2 Seismic Design Parameters

CBC Chapter 16	2019 ASCE 7-16 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)	Seismic Coefficient, S_s	1.739 g
1613A5.3(2)	Seismic Coefficient, S_1	0.699 g
1613A5.3(1)	Site Class D / Seismic Coefficient, F_a	1.0 g
1613A5.3(2)	Site Class D / Seismic Coefficient, F_v	n/a
16A-37 Equation	Spectral Response Accelerations, $S_{Ms} = F_a S_s$	1.739 g
16A-38 Equation	Spectral Response Accelerations, $S_{M1} = F_v S_1$	n/a
16A-39 Equation	Design Spectral Response Accelerations, $S_{Ds} = 2/3 \times S_{Ms}$	1.159 g
16A-40 Equation	Design Spectral Response Accelerations, $S_{D1} = 2/3 \times S_{M1}$	n/a

It should be noted that lateral force requirement in design by structural engineer should be intended to resist total structural collapse during an earthquake. During lifetime use of the structure built, it is our opinion that some structural damage may be anticipated requiring structural repairs. Adequate structural design and implementations in construction should be strictly observed.

4.0 Evaluations and General Recommendations

4.1 General Evaluations

Based on field explorations, laboratory testing and subsequent engineering analysis completed at this time, the following tentative conclusions and recommendations are presented for the site under study. Supplemental recommendations may be warranted following detailed development plan review.

(i) Moderate site clearance should be expected, including demolition of the existing retail structure.
(ii) From geotechnical viewpoint, the site is considered grossly stable for the proposed development.
(iii) Because of the near surface compressible/collapsible soils existing as encountered, for adequate structural support conventional site preparations should be expected in the form of about 24-inch subexcavations/scarification or cross-ripping, followed by the excavated soils replacement to proposed grade compacted to minimum 95% at near optimum moisture content.
(iv) Near grade soils existing within load bearing areas, should include further site preparations and grading in the form of minimum 24-inch subexcavations followed by the excavated soils replacement as engineered fills compacted to 95% or better. In event new fill soils are required, such should be placed similarly compacted to 95%.
(v) The sub-excavation described should be considered as "minimum". During grading localized deeper sub-excavations may be required following removal of tree stumps and within areas of buried debris, irrigation pipes etc. It will be the responsibility of the grading contractor to inform soils engineer the presence of such, if and when exposed.
(vi) In order to minimize potential excessive differential settlements, it is recommended that structural footings should be established exclusively into engineered fills of local sandy soils or its equivalent or better, compacted to minimum 95% of the soils' Maximum Dry Density at near Optimum Moisture conditions. Construction of footings and slabs straddling over cut/fill transition should be avoided.
(vii) Structural design considerations should include probability for "moderate to high" peak ground acceleration from relatively active nearby earthquake faults existing as described. The effects of ground shaking, however, may be minimized implementing the seismic design requirements and the design procedures as outlined in the current CBC and as described in earlier sections of this report.
(viii) Provisions should be maintained during construction to divert incidental rainfall away from the structural pad constructed.
(ix) It is our opinion that, if site preparations and grading are performed as per the generally accepted construction practices, the proposed development will not adversely affect the stability of the site or to the properties adjacent.
(x) It is recommended that following mass-grading completion, soil expansion potential should be further verified based on which revised recommendations for footings and slab-on-grade may be warranted.

4.1.1 Preparations for Structural Pads

Although no detailed development plans are available for review, it is our opinion that the subject development will primarily include a subterranean basement along with 8-10 feet high retaining wall with conventional wall footings. Such retaining wall, preferably supported by engineered graded fills placed as described, should be compacted to 95%.

Supplemental construction is expected to include isolated square spread footings along the edge of subterranean parking garage level to support the 4-story super structure proposed. The load bearing spread footings are assumed to support maximum vertical loading of about 40 kips. The pedestal footings are expected to support maximum vertical loadings of 40 kips.

4.2 Structural Foundations

Based on the limited project information supplied, it is understood that the subject development will include a 4-story multi-family residential complex of concrete block wall and conventional wood frame and stucco construction with concrete slab-on-grade garage for auto parking. Moderate site preparations and grading should be expected for the development proposed.

The assumed structure may be supported by continuous wall and/or isolated spread footings founded exclusively into engineered fills of local soils compacted to minimum 95%. Use of footings straddling over cut/fill transition, shall be avoided. Excavated footings trenches should be sufficiently "moistened", re-compacted if necessary and verified and approved in writing by the soils engineer immediately prior to concrete placement. Use of low-slump concrete is suggested.

In general, isolated square spread foundations should be sized to minimum 36-inches wide and embedded to minimum 24-inches below the lowest grade. Isolated footings described should be reinforced using #5 rebar or as selected by the project structural engineer. Wall footings should be 18-inches or as designed by the structural engineer.

Isolated and continuous wall footings may be designed using the following equations

Continuous Wall Footings: $q_{allowable} = 1800 + 300d + 250b$,
Square Footings: $q_{allowable} = 1500 + 300d + 200b$, where

$q_{allowable}$= allowable soil vertical bearing capacity, psf,
d = footing depth, minimum recommended 2 feet,
b = footing width, minimum recommended 3 feet.

Based on the laboratory determined soils consolidation characteristics, settlements to properly designed and constructed foundations supported exclusively into engineered fills of local soils carrying the assumed maximum anticipated structural loadings of 40 kips, are expected to be within tolerable limits.

Use of footings straddling over cut/fill transition, shall be avoided. Excavated footings trenches should be sufficiently "moistened", re-compacted if necessary, and verified and approved in writing by soils engineer immediately prior to concrete placement.

It is recommended that excavated footing trenches should be verified by the soils engineer prior to the actual forming, rebar, and concrete placement. Soils Southwest, Inc. will assume no responsibility for any structural distress in event excavated footings are not verified as described prior to concrete placement.

Settlement: Under static loading conditions, over a 40-foot span, estimated total and differential settlements are about 1 and ½-inch, respectively. Most of the elastic deformations, however, are expected to occur during construction.

Under seismic loading conditions, retaining structure should be designed based on the following general equation:

Active:	k_a = 35 pcf
Seismic:	$k_{he} = 3/8\ \gamma\ H^2(a_{max}/g)$
At Rest:	80 pcf

where γ = soils' density, 120 pcf,
H= wall height or footing depth, feet,
a_{max} = maximum horizontal ground acceleration due to an earthquake, ft/sec^2
g = acceleration due to gravity, 32.2 lb/ft^3
k_a= earth pressure coefficient, and
k_{he}= horizontal component of vertical load, 40 kips.

For estimation purposes, the area of planned development should be cleared of the existing structure, parking pavement, vegetation, miscellaneous debris, other non-structural materials, and the subgrades exposed following the vertical cuts required for garage retaining wall. Once disposed, site grading should include sub-excavations of the near grade soils estimated to about 8-10 feet below grade near the north, or to the depth as approved by soils engineer during grading.

In general, an overall minimum 6 to 8-feet-thick compacted fill mat blanket should be maintained underneath load bearing foundations and 5 feet beyond. Similar fill mat is also recommended within the areas of the concrete slab-on-grade for the parking garage proposed.

Additional subexcavation may be warranted within isolated areas underlain by unsuitable subgrades as determined by soils engineer during mass grading. Imported fills, if required, should be approved by the soils engineer prior to their use. General Earthwork recommendations are enclosed in Section 5 of this report. Supplemental recommendations may be warranted following detailed development plan review.

4.3 Structural Fill Soils Material

The local silty sandy soils free of organic, roots, debris, and rocks larger than 6-inch in diameter should be considered suitable for reuse as structural backfills.

Although no significant variations in soil conditions are anticipated, actual soils conditions may vary during grading. It will be the subcontractor's responsibility to notify Soils Southwest, Inc. about subsoil variations for revised/updated recommendations, if any.

Backfills placed should be compacted to minimum 90% of the soils' Maximum Dry Density as determined by the ASTM D1557 test method. Import soils, if required, should be gravelly sandy in nature as approved by the soils engineer. In general, imported fill soils for structural support shall be "zero-to-very low" in expansion potential, meeting the following criteria:

Liquid Limit	< 35
Plasticity Index	< 15
Expansion Index	< 20

4.3.1 Structural Fill Placement

Structural fills shall be placed in 6 to 8-inch lifts with near Optimum Moisture conditions compacted to the minimum recommended. No fills shall be placed during unfavorable weather conditions.

Supplemental recommendations may be warranted following detailed development plan review.
Should the project structural engineer determine that more stringent design criteria should be required, then the above recommendations should be superseded to the satisfactions of the project design professionals.

Based on review of the development plan supplied, it is understood that the subject project will include a major vertical cut of approximately 10 feet surrounding the proposed basement parking garage. Considering the presence of silty gravelly medium to coarse sands, it is our opinion that no unsupported vertical cut above 4-feet in height and 5 feet in width should be excavated, to avoid excessive caving and collapse. However, the vertical cut required for the proposed parking garage is suggested to be excavated using alternative A-B-C slot-cuts method. Alternatively, slot-cuts proposed may be accomplished by using soil-nailing performed by an experienced contractor or by any other procedure suggested by the project structural engineer and contractor. For lateral support of the excavation described steel I-beam soldier piles with prefabricated concrete lateral "laths" should be installed. The piles described should be spaced and embedded to the depth as suggested by the project structural engineer.

The above suggestions are for estimation purposes only. Actual recommendations for soldier pile dimensions, reinforcement requirements, installation intervals, and excavation methods, and others should be supplied by the project structural engineer.

4.4 Concrete Slab-on-Grades

No concrete slab-on-grade, sidewalks, and flatworks should be placed directly bearing on the surface soils currently existing. Placement of such may be considered using site clearance of existing development followed by 12-inch subexcavation and recompaction to 95%.

Within moisture sensitive areas, concrete slabs should be underlain by 2-inches of compacted clean sands, followed by 12-mil-thick commercially available approved vapor barrier such as "StegoWrap" or its similar, overlying additional 2-inch-thick compacted clean sands, followed by reinforcing as suggested.

The gravelly sands used should have laboratory determined Sand Equivalent, SE, of 30 or greater.

Subgrades to receive concrete should be "pre-moistened" as would be expected in any such concrete placement. Use of low-slump concrete is recommended. In addition, it is recommended that utility trenches underneath concrete slabs and driveways should be thoroughly backfilled with gravelly sandy soils, mechanically compacted to the recommended minimum prior to concrete pour.

Supplemental recommendations may be warranted following detailed development plan review.

4.4.1 Concrete Curing and Crack Control

The recommendations presented are intended to reduce potential for cracking of concrete slabs-on-grade due to concrete curing or settlement. It is our opinion that following concrete slab-on-grade placement for garage slab and concrete driveways stucco walls and concrete slabs-on-grade may display some minor cracking due to minor soil movement and/or concrete shrinkage.

To reduce and/or control concrete shrinkage, curling or cracking, concrete slabs shall be "cured" using commercially concrete curing agent.

To minimize potentials for "warping", subgrade soils to receive concrete shall be free of excess water and concrete shall not be placed during adverse weather conditions such as during high temperature or during high Santa Ana wind conditions.

4.5 Resistance to Lateral Loads

Under static loading conditions, it is our opinion that for the proposed development, resistance to lateral loads for footings, retaining wall etc. may be restrained by friction and passive earth pressure for the construction in contact with the graded fills. A coefficient of friction of 0.35 may be assumed with normal dead load forces for footings established on engineered fills of local soils compacted to minimum 95%.

An allowable passive lateral earth resistance of 250 psf per foot of depth may be assumed for the sides of foundations poured against compacted fill local soils or its similar. The maximum lateral passive earth pressure is recommended not to exceed 2500 psf.

For design, lateral pressures from local soils when used as level backfill may be estimated from the following equivalent fluid density:

Active:	30 pcf
At Rest:	60 pcf

The above values may be increased by 1/3 when designing for short duration wind or seismic forces. The above values are based on footings placed on compacted engineered fills. Where footing sides are formed, all backfill placed against the footings should be compacted to the minimum compaction requirements described earlier.

Supplemental recommendations may be warranted following detailed development plan review.

4.6 Shrinkage and Subsidence

Based on the results of field observations and laboratory testing, it is our opinion that the upper soils when used in grading may be subjected to a volume change. Assuming a 95% relative and assuming an compaction such volume change due to shrinkage may be on the order of 10% to 14%. Further volume change may be expected following removal of cobbles, large rocks over 6-inch in overall dimensions, underground utilities, surface vegetation, and others.

Supplemental shrinkage is expected during the preparation of the underlying natural soils prior to compacted fill soils placement. For estimation purpose, subsidence may be approximated to about 2.5-inches when conventional construction equipment is used.

4.7 Construction Considerations

4.7.1 Unsupported Excavations

Temporary construction excavation up to a depth of 4-feet may be made without any lateral support. It is recommended that no surcharge loads such as construction equipment, be allowed within a line drawn upward at 45-degrees from the toe of temporary excavations. Use of sloping for deep excavation may be considered where plan excavation dimensions are not constrained by any existing structure.

4.7.2 Supported Excavations

If vertical excavations exceeding 4-feet in depth become warranted, such should be achieved using shoring to support side walls.

4.8 Site Preparations

Following removal of the existing structure and paving, it is our opinion that the site preparation should include 8 to 10-foot-deep subexcavation and their removal to accommodate the subterranean garage parking.

4.9 Soil Caving

Considering the gravelly sandy site soils as encountered, some caving may be expected during deep excavations. Temporary excavations in excess of 5-feet may require shoring and be made at a slope ratio of 2:1 (h:v) or flatter or as per the construction guidelines as provided by Cal-Osha.

4.10 Structural Pavement Thickness

Driveways: Asphalt paving when used, it is our opinion that the subgrade soils should be scarified to minimum 12-inches, moisture conditioned from 3% to 5% over Optimum Moisture, and recompacted to at least 95% of soils' Maximum Dry Density as determined by the ASTM D1557 method. Base materials and asphalt used should be compacted to minimum 95% or as required by the local public agencies.

The pavement evaluations are based on an estimated Traffic Index, TI, of 6.5 and an estimated soil R-value of 50. It is recommended that following mass grading completion, representative site soils should be laboratory tested to determined soil's R-value, based on which actual paving thickness should be determined.

Subterranean Garage: Following overexcavation to the planned garage level of about 8 to 10-feet, it is our opinion that the surface exposed should be further subexcavated/scarified to minimum 12-inches and recompacted to minimum 95% prior to concrete placement.

Concrete paving thickness for the proposed parking garage is suggested to be a minimum of 5-inch-thick, reinforced with #5 rebar at 24-inches o/c placed directly over the local sandy gravelly soils compacted to minimum 95%. Actual paving thickness should be supplied by the project structural engineer based on soils' Subgrade Reaction, k_c = 200 kcf.

4.11 Utility Trenches Backfill

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

- Trenches backfill should be placed in thin lifts compacted to 90% or better of the laboratory maximum dry density for the soils used. As an alternative, clean granular sand may be used having Sand Equivalent, SE, of minimum 30. Jetting is not recommended within utility trench backfill.

- 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% 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.

Supplemental recommendations may be warranted following detailed development plan review.

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

To minimize potential differential settlement to foundations, 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.

4.14 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.

4.15 Observations and Testing During Construction

No detailed grading and development plans for the project are available for review. Recommendations provided assumes that structural footings and slab-on-grade should be established exclusively into engineered fills compacted to minimum 90%. Excavated footings should be inspected, verified and certified by soils engineer prior to steel and concrete placement to ensure their sufficient embedment and proper bearing as recommended. Structural backfills discussed should be placed under direct observations and testing by this facility. Excess soils generated from footing excavations should be removed from pad areas and such should not be allowed on planned subgrades to receive concrete slabs.

In event other geotechnical consultants are retained during grading, Soils Southwest, Inc. will not be held responsible for any distress that may occur during life-time use of the structures constructed.

4.16 Plan Review

In absence of grading and development plan review, the recommendations supplied should be considered "preliminary". When prepared, such grading and development plans should be reviewed in order verify adequacy of the geotechnical recommendations supplied. Where warranted, supplemental recommendations will be supplied following grading and development plans review.

4.17 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 grading contractor prior to any grading and construction.

5.0 Earthwork/General Grading Recommendations

Site preparations and grading should involve overexcavation and replacement of local soils as structural fill compacted to 95% or better. Although no significant variations in soil conditions are anticipated, actual soils conditions may vary in the event subgrades exposed during construction are found different from those as described in this report. It will be the subcontractor's responsibility to notify Soils Southwest, Inc. about sub soil variation, if any, for revised/updated recommendations.

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. Additional recommendations on such will be supplied upon request.

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.

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, 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 the minimum as recommended. In order to minimize potential differential settlements to foundations and slabs straddling over cut and fill transition. Where warranted, cut portions following cut, should be further over excavated and such be replaced as engineered fill compacted to the minimum percentage requirements recommended earlier.

4. Utility trenches within building pad areas and beyond should be backfilled with granular material and such should be mechanically compacted to minimum percentage compaction requirement as described.

5. Compaction for structural fills shall be determined relative to the Maximum Dry Density as determined by the ASTM Standard D1557 compaction methods. In-situ field density of compacted fill shall be determined by the ASTM D1556-82 by using Sand Cone, or by ASTM D1527 Standard Methods using Nuclear Density Gauge, or by other approved test procedures.

6. Use of the imported soils, if required, shall be clean granular, non-expansive in nature 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 jetting shall 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, sidewalks or other facilities to be used by the general public, should be constructed under direct observation of the soils engineer or as required by the local public agencies.

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

6.0 Closure

In absence of detailed grading and/or development plan, the conclusions and recommendations presented should be considered "tentative" subject to revision following development plan review. Accordingly, supplemental investigation and engineering evaluations may be warranted.

Recommendations provided are based on the assumptions that structural footings will be established exclusively into compacted fills of local silty sandy soils with Expansion Index, EI, of less than 20.

Final grading and foundation plans should be reviewed by this office when they become available. Site grading must be performed under continuous inspection and testing by geotechnical representative of this office. Excavated footings should be inspected and approved by soils engineer prior to steel and concrete placement to ensure that foundations are established into satisfactory soils and excavations are free of loose and disturbed materials.

A pre-grading 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.

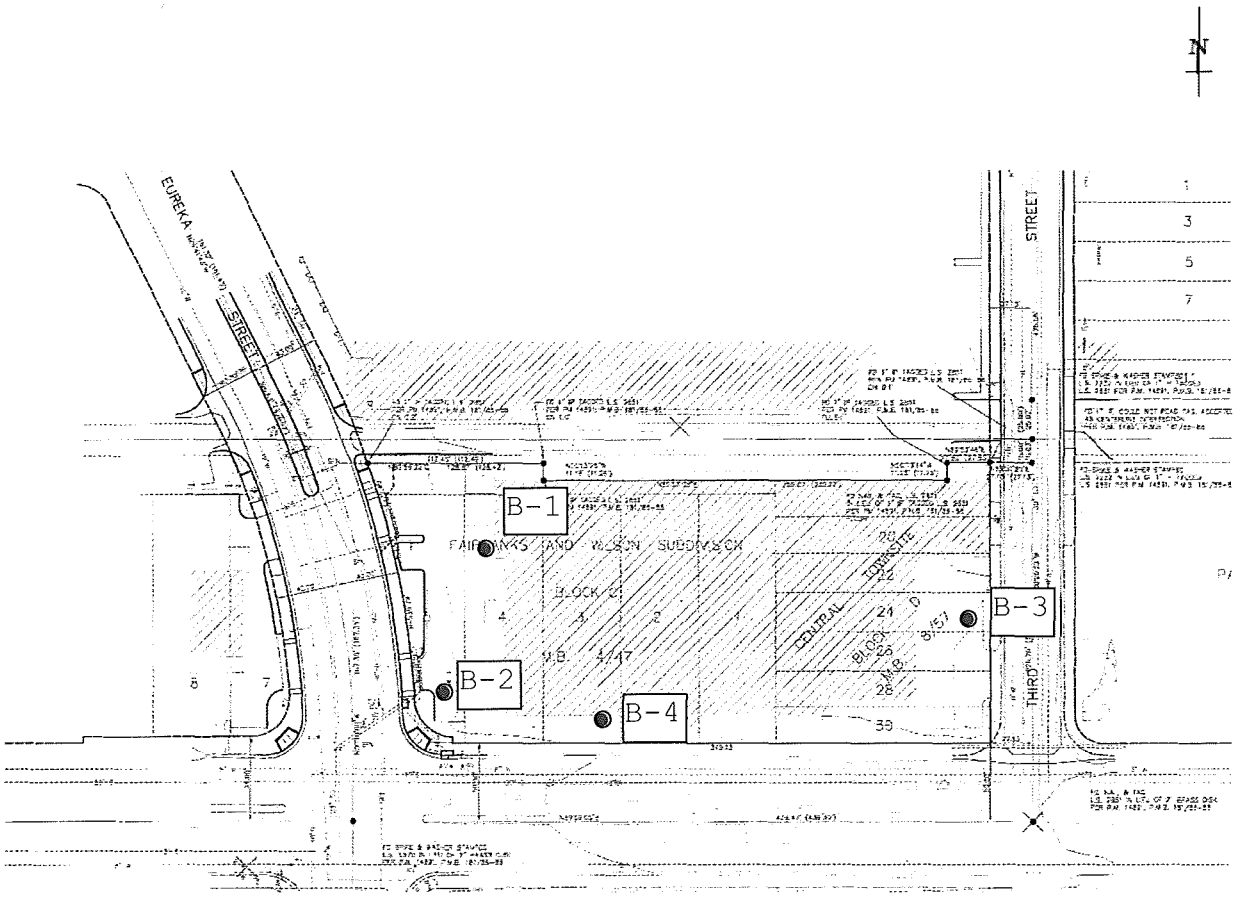
Should the project be delayed beyond one year after the date of this report; the recommendations presented shall be reviewed to consider any possible change in site conditions.

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 THE LIFETIME USE OF THE STRUCTURES CONSTRUCTED.

PLOT PLAN AND TEST LOCATIONS
Proposed 4-Story, 146-Unit The Grand Apartment Complex
200 W. Redlands Boulevard
Redlands, CA
APN: 0169-281-30&31

(Not to Scale)



Legend: ● B-1 Approximate Location of Test Borings Plate A

7.0 APPENDIX A

Field Explorations

Field evaluations included site reconnaissance and four (4) exploratory test borings using a mounted hollow-stem auger drill-rig along with one (1) hand auger boring advanced to the maximum exploration depth of 31-feet below grade where accessible. During site reconnaissance, the surface conditions were noted and test excavation locations were determined.

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 A.

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-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 samples, bulk soil samples were procured as described in the logs.

Logs of test explorations are presented in the following summary sheets that include the description of the soils and/or of the 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: Vantage One/The Grand		**Job No.:** 19034-F
Logged By: John F.	**Boring Diam.:** 8" HSA	**Date:** 5-14-22

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			Asphalt
								SAND - brown to dark brown, traces of silt, fine to medium coarse, pebbles, rock fragments, damp
							5	
37	■	5.1	121.8	99				- color change to brown, traces of silt, gravely, fine to coarse, pebbles, rock fragments, scattered 1/2"-1" rock
							10	
47	◪							- color change to grayish light brown, gravely, medium to coarse, pebbles, rock fragments with rippible rock
					GP-SP			- dense to very dense
								GRAVELS- rocks and cobbles with some light brown, fine to medium coarse sand dense
							15	
							20	
33	◪							
							25	
								- gravely medium coarse to coarse, rock fragments, occasional rock, dense
							30	
37	◪							- dense
								- 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 Multi-Family Residential 200 W. Redlands Boulevard Redlands, California	**Plate #**

■ 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: Vantage One/The Grand		**Job No.:** 19034-F
Logged By: John F.	**Boring Diam.:** 8" HSA	**Date:** 5-14-22

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
					GP-SP			Asphalt
								SAND - light brown, gravely, medium to medium coarse, pebbles, occasional rock fragments and rock 1/2"-1", dry
10		2.5	105.3	85.6	SP			- color change to light brown to grayish light brown, fine to medium coarse, pebbles, rock fragments, rock 1", low density
					GP-SP		5	
11								- (Max Dry Density = 123 pcf @ 9.5%)
								- medium to medium coarse, gravely
27		2.7	118.7	96.5				- gravely, medium coarse, pebbles, rock fragments, dry, low to medium dense
							10	- gravely, medium to coarse, rock fragments dense
50								- color change to brown, gravely, medium coarse to coarse, rock fragments, occasional 1/2"-1" rock, very dense, damp
							15	
16					SP			- color change to orangish brown, traces of silt, fine to medium coarse, pebbles, rock fragments, medium dense, 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 Multi-Family Residential
200 W. Redlands Boulevard
Redlands, California

Plate #

California sampler | Bulk/Grab sample | 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: Vantage One/The Grand		**Job No.:** 19034-F
Logged By: John F.	**Boring Diam.:** 8" HSA	**Date:** 5-14-22

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			Asphalt
					SM			SAND - gray brown, slightly silty, fine to medium, pebbles, rock fragments
					SP-SM			- color change to tannish light brown, silty fine to medium, scattered rocks
							5	- color change to dark brown, slightly silty fine to medium, occasional rock fragments scattered rock, damp
35					GM-SM			GRAVELS-rocks with some silty fine to medium coarse sands, dry, dense
					GP-SP			SAND - color change to grayish brown, gravely, medium to coarse, rock fragments and occasional rocks and cobbles
33								
					GP		10	
50								GRAVELS- rocks and cobbles with little soil NO SAMPLE RECOVERY
							15	
							20	
					SP			SAND - color change to tannish brown to yellow, traces of silts, fine to medium coarse, pebbles, rock fragments, scattered rock, dense, dry
32								- dense
							25	- End of test boring @ 20 ft. - no bedrock - no groundwater
							30	

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

Site Location

Proposed Multi-Family Residential
200 W. Redlands Boulevard
Redlands, California

Plate #

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: Vantage One/The Grand		**Job No.:** 19034-F
Logged By: John F.	**Boring Diam.:** Hand Auger	**Date:** 5-14-22

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			grass
								SAND - dark brown, slightly silty, fine to medium, pebbles, rock fragments, damp
					SP		5	- color change to light brown, gravely, medium to medium coarse, pebbles, rock fragments, dry, loose
								-NO SAMPLE RECOVERY
								- Abandoned test boring @ 6 ft. due to resistance (rock - 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 Multi-Family Residential 200 W. Redlands Boulevard Redlands, California	**Plate #**

California sampler Standard penetration test Bulk/Grab sample

KEY TO SYMBOLS

Symbol Description

Strata symbols

Poorly graded sand

Poorly graded gravel and sand

Poorly graded sand with silt

Silty sand

Silty sand and gravel

Poorly graded gravel

Soil Samplers

California sampler

Standard penetration test

Bulk/Grab sample

Notes:

1. Exploratory borings were drilled on 5-14-22 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

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 the 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 a 1-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 (D4829):

Considering gravelly sandy nature, the site soils are considered are considered "very low" soil expansion characteristic with an Expansion Index, EI potential of less than 20.

Laboratory Test Results

A. Table 1: Moisture-Density Determinations (ASTM D2216)

Sample Location & Sample Depth (feet)	Dry Density (pcf)	Moisture Content (%)	Laboratory Maximum Dry Density (pcf)	Relative Percent Compaction (%)
B-1@ 5.0	121.8	5.1	123	99.0
B-2 @ 20.0	105.3	2.5	123	85.6
B-2 @ 3.0	118.7	2.71	123	96.5

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

Sample Location, @ Depth (feet)	Max. Dry Density (pcf)	Opt. Moisture (%)
B-2 @ 3'-5' Sand-brown, gravely, medium to Medium coarse, pebbles, rock fragments, rocks 1"-2", cobbles, scattered roots and organic debris	123	9.5

C. Table III: Direct Shear (ASTM D3080)

Test Boring & Sample Depth (feet)	Test Condition	Cohesion (PSF)	Friction (Degree)
B-2 @ 3 to 5	Remolded to 90%	240.0	38.0
B-2 @ 8.0	Undisturbed	0.12	49.00

D. Table IV: Consolidation (D2435)

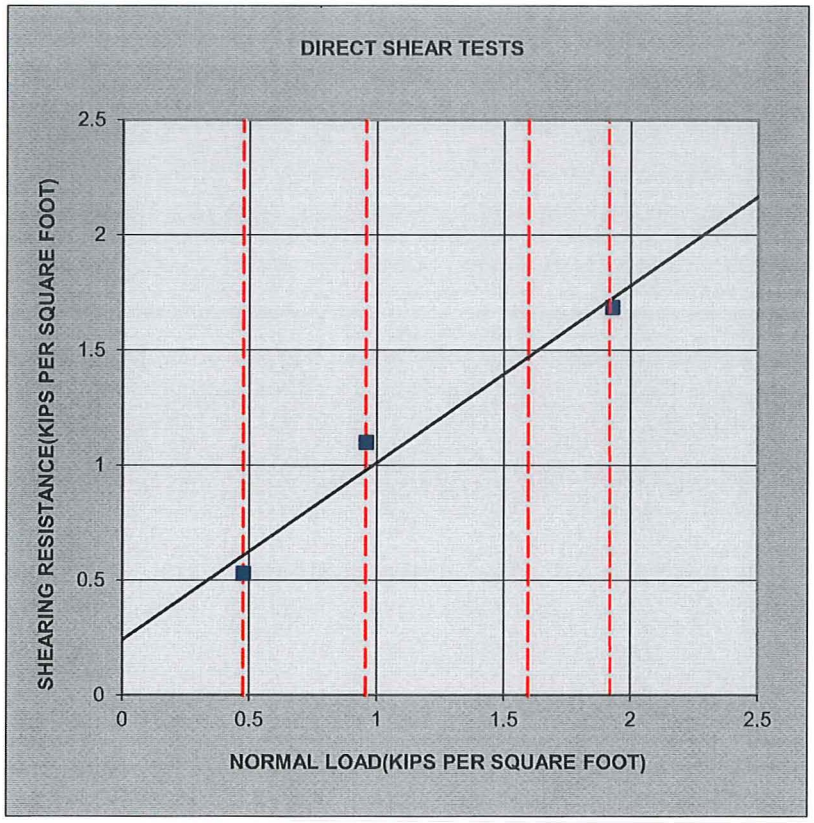
Boring, B #	Depth (feet)	Consolidation Prior to Saturation (%) @ 2 kips	Hydro Collapse (%) @ 2 kips	Total Consolidation (%) @ 8 kips (saturated)
2 (remolded to 90%)	3-5	0.4	0.1	1.7
1 (undisturbed)	5.0	1.4	2.4	6.6
2 (undisturbed)	8.0	0.6	1.3	4.1

E. Table V: Soils Expansion Index, EI (ASTM D4829)

Sample Location @ Soils Depth	Soil Expansion Index, EI	Expansion Potential
B-2 @ 3'-5'	17	"very low"

F. Table VI: Sieve Analysis (ASTM D 422)
Sample B-2 @ 3'-5'

Grain Size	% Retained
Gravels	23
Medium to Coarse	47
Fines	24
Silts	6



SYMBOL	LOCATION	DEPTH (FT)	TEST CONDITION	COHESION (psf)	FRICTION (degree)
■	B-2	3 to 5	Remolded to 90%	240.27	37.62

Proposed Multi-Family Residential Complex 200 W. Redlands Boulevard Redlands, California	PROJECT NO.	19034-F
	PLATE	B-1

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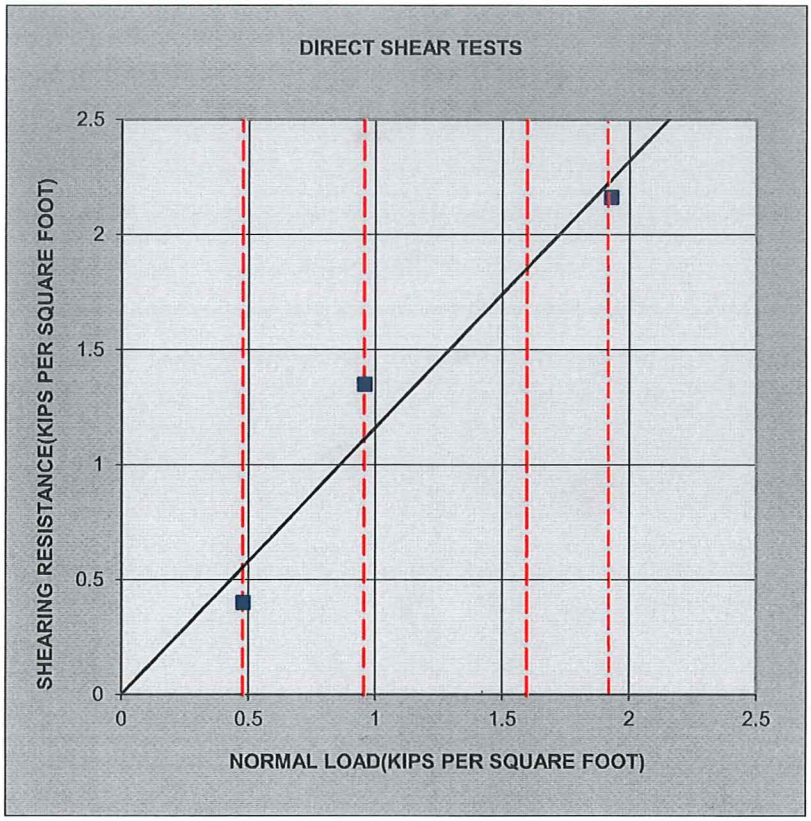
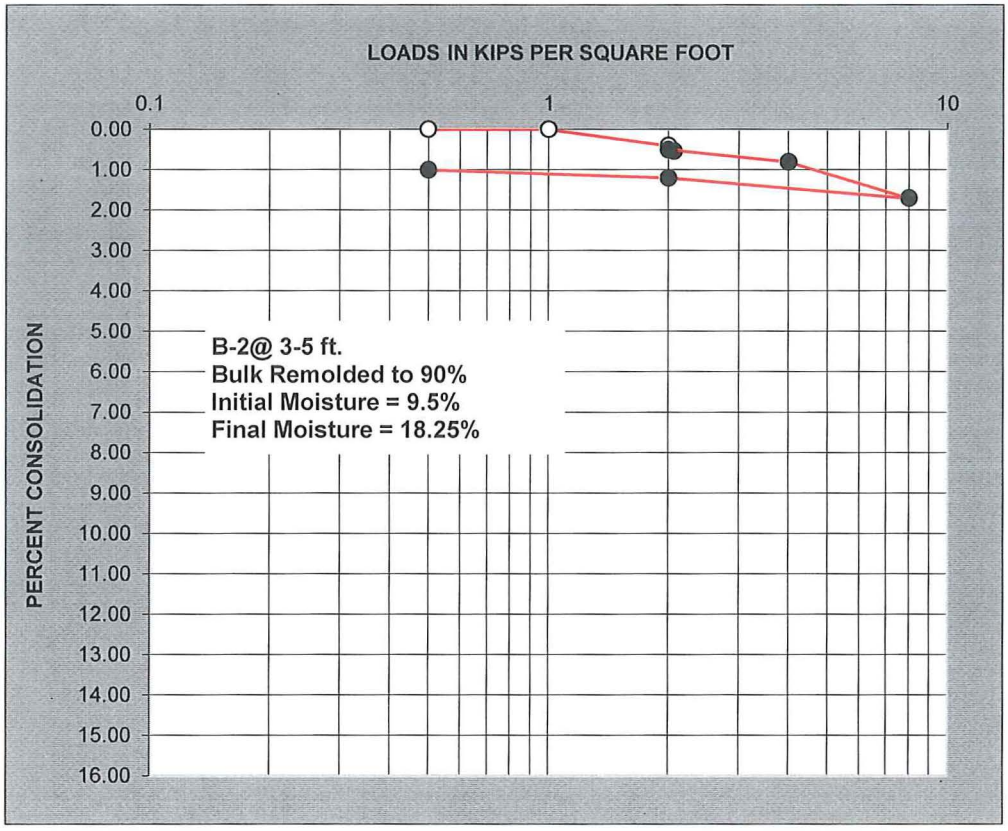


SYMBOL	LOCATION	DEPTH (FT)	TEST CONDITION	COHESION (psf)	FRICTION (degree)
■	B-2	8 ft.	Undisturbed	0.12	49.26

Proposed Multi-Family Residential Complex 200 W. Redlands Boulevard Redlands, California	PROJECT NO.	19034-F
	PLATE	B-1-1

SOILS SOUTHWEST, INC.
Consulting Foundation Engineers

CONSOLIDATION TESTS

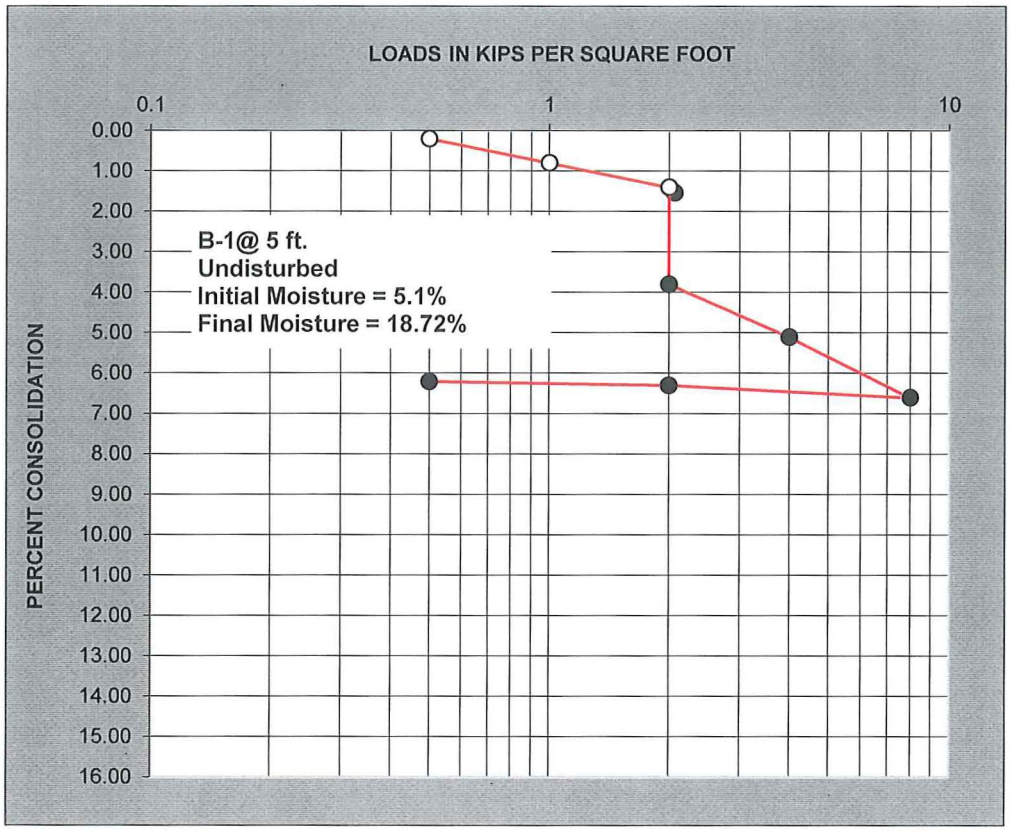


- **WATER PERMITTED TO CONTACT SAMPLE**

	PROJECT	Proposed Multi-family Residential Complex 200 W. Redlands Boulevard, Redlands		
	PROJECT NO.	19034-F	PLATE	B-2

SOILS SOUTHWEST INC.
Consulting Foundation Engineers

CONSOLIDATION TESTS

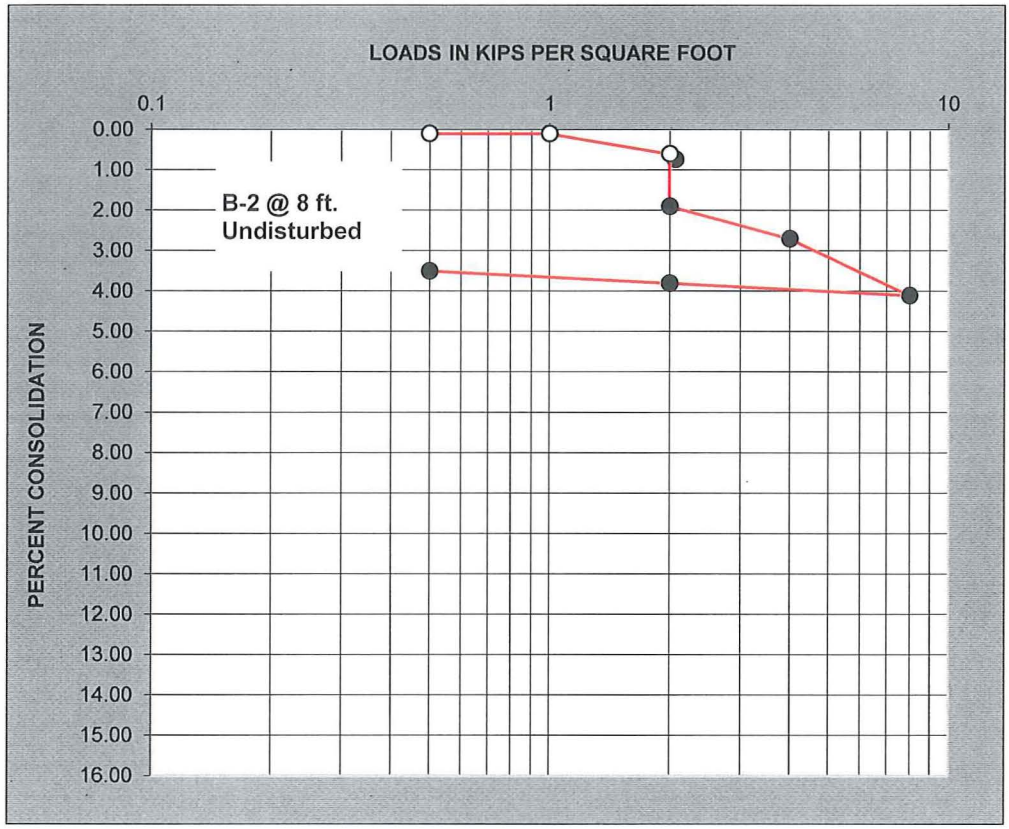


- **WATER PERMITTED TO CONTACT SAMPLE**

	PROJECT	Proposed Multi-family Residential Complex 200 W. Redlands Boulevard, Redlands		
	PROJECT NO.	19034-F	PLATE	B-2-1

SOILS SOUTHWEST INC.
Consulting Foundation Engineers

CONSOLIDATION TESTS



- **WATER PERMITTED TO CONTACT SAMPLE**

	PROJECT	Proposed Multi-family Residential Complex 200 W. Redlands Boulevard, Redlands		
	PROJECT NO.	19034-F	PLATE	B-2-2

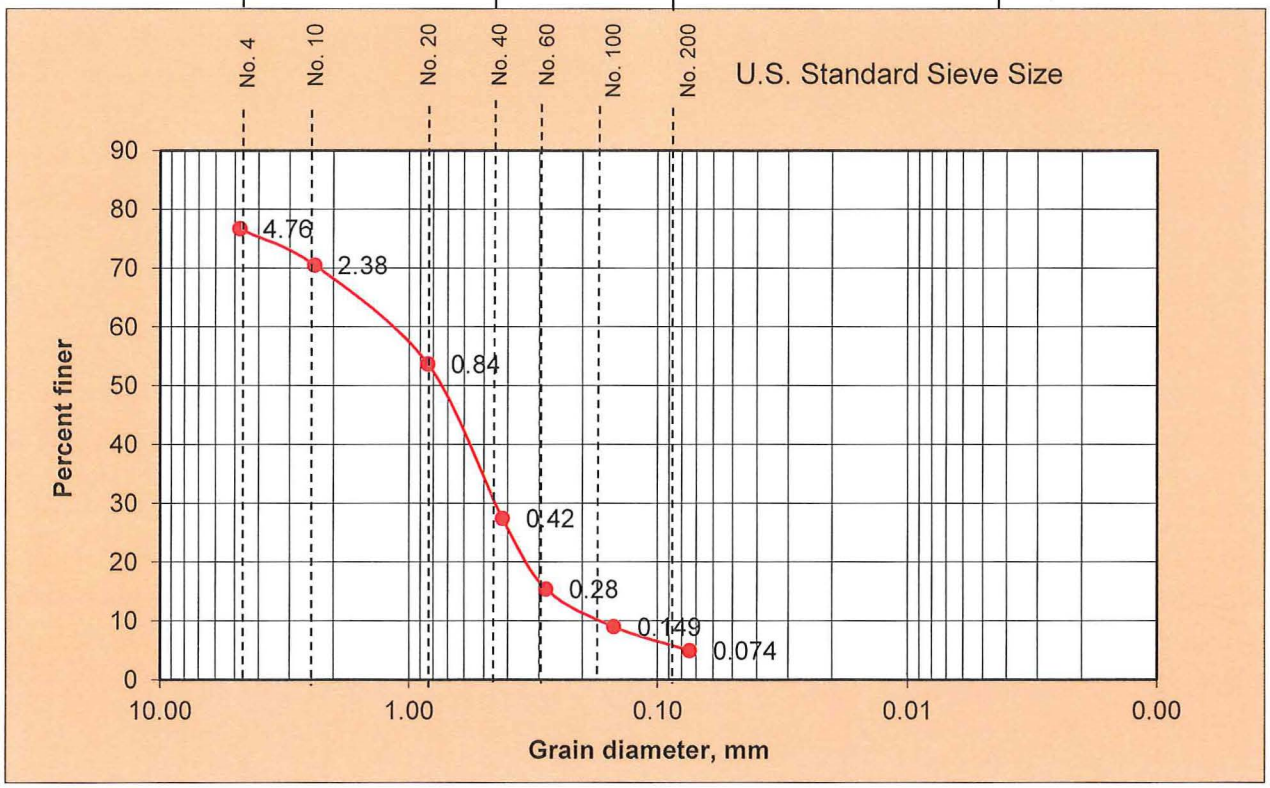
SOILS SOUTHWEST INC.
Consulting Foundation Engineers

GRAIN SIZE DISTRIBUTION

Project: Vantage One The Grand **Job #** 19034-F
Location: 200 W. Redlands Blvd, Redlands **Boring No:** B-2 **Sample No:**
Description of Soil: Brownish grey, medium coarse to fine, gravels, and slightly silty
Date of Sample: 3/28/2022
Tested By: Alex **Date of Testing:** 5/17/2022

Sieve No.	Sieve Openings in mm	Percent Finer	Grain Size	% Retained
4	4.76	76.76	Gravel	23
10	2.38	70.56	Med. to Crs	47
20	0.84	53.74	Fines	24
40	0.42	27.50	Silts	6
60	0.28	15.48	Clays	0
100	0.149	9.06		
200	0.074	5.02		

Gravel	Sand			
	Coarse to Medium	Fine	Silt	Clay



Visual Soil Description : Sand - medium coarse, gravelly sands, fines, with some silts

Soil Classification: GP-SW

System: USC

SOILS SOUTHWEST INC.
Consulting Foundation Engineers

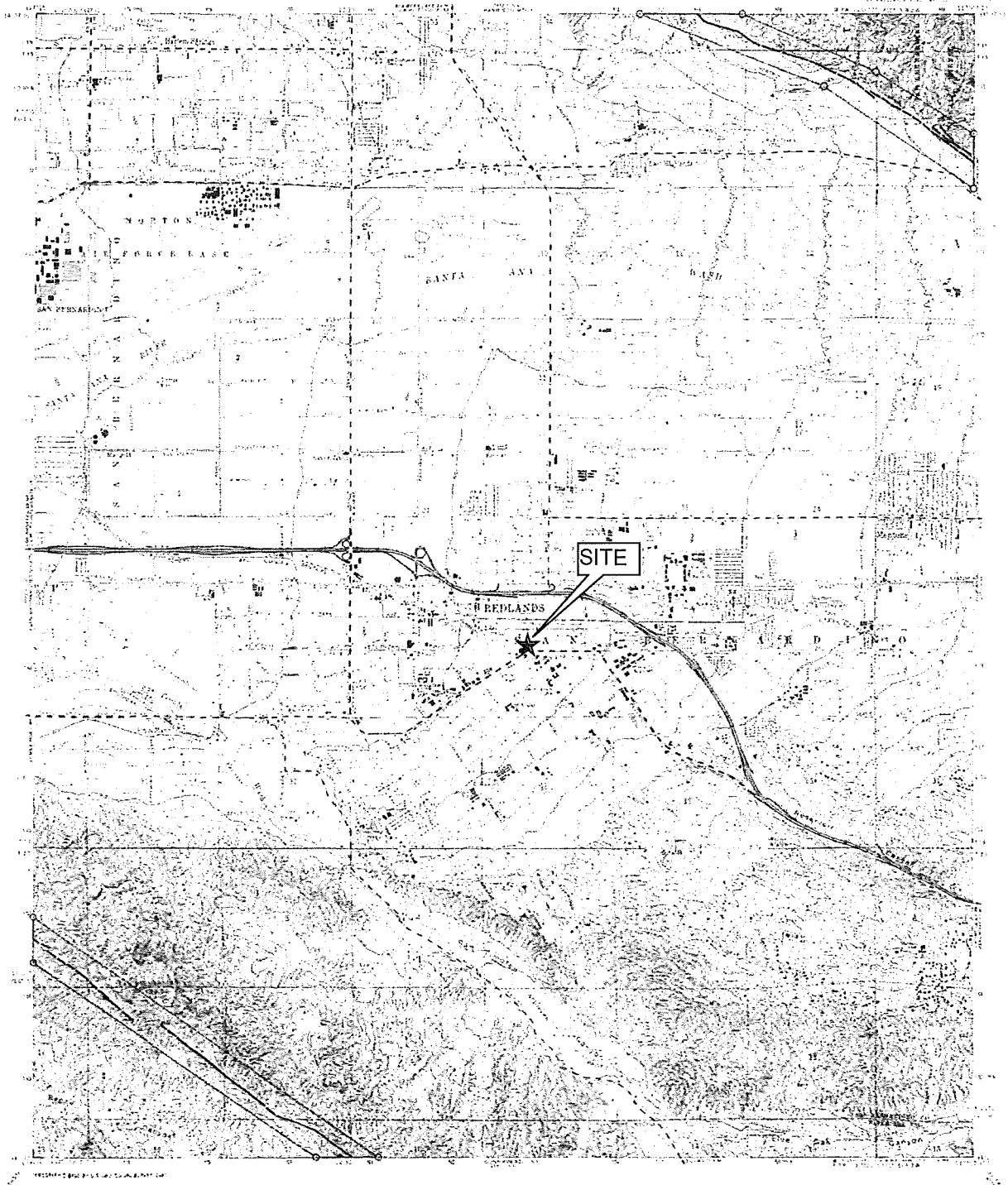
APPENDIX C

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)



SCALE 1:24 000

CONTOUR INTERVAL 25 FEET

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

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 Jr. / 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 2621 of the California Public Resources Code.

U.S. Geological Survey - Earthquake Hazards Program

2008 National Seismic Hazard Maps - Source Parameters

New Search

Distance in Miles	Name	State	Pref Slip Rate (mm/yr)	Dip (degrees)	Dip Dir	Slip Sense	Rupture Top (km)	Rupture Bottom (km)	Length (km)
4.08	San Jacinto;SJV+A	CA	n/a	90	V	strike slip	0	17	89
4.08	San Jacinto;SJV+A+CC	CA	n/a	90	V	strike slip	0	16	136
4.08	San Jacinto;SJV+A+CC+B	CA	n/a	90	V	strike slip	0.1	15	170
4.08	San Jacinto;SJV+A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	196
4.08	San Jacinto;SJV+A+C	CA	n/a	90	V	strike slip	0	17	136
4.08	San Jacinto;SJV	CA	18	90	V	strike slip	0	16	43
4.08	San Jacinto;SBV+SJV	CA	n/a	90	V	strike slip	0	16	88
4.08	San Jacinto;SBV+SJV+A	CA	n/a	90	V	strike slip	0	16	134
4.08	San Jacinto;SBV+SJV+A+C	CA	n/a	90	V	strike slip	0	17	181
4.08	San Jacinto;SBV+SJV+A+CC	CA	n/a	90	V	strike slip	0	16	181
4.08	San Jacinto;SBV+SJV+A+CC+B	CA	n/a	90	V	strike slip	0.1	15	215
4.08	San Jacinto;SBV+SJV+A+CC+B+SM	CA	n/a	90	V	strike slip	0.1	15	241
4.11	San Jacinto;SBV	CA	6	90	V	strike slip	0	16	45
4.94	S. San Andreas;BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	85		strike slip	0.1	13	390
4.94	S. San Andreas;CH+CC+BB+NM+SM+NSB+SSB+BG+CO	CA	n/a	86		strike slip	0.1	13	512
4.94	S. San Andreas;SSB+BG	CA	n/a	71		strike slip	0	13	101
4.94	S. San Andreas;NSB+SSB+BG+CO	CA	n/a	79		strike slip	0.2	12	206

U.S. Geological Survey - Earthquake Hazards Program

2008 National Seismic Hazard Maps - Source Parameters

New Search

Fault Name	State
San Jacinto;SJV+A	**California**

GEOMETRY	
Dip (degrees)	90
Dip direction	V
Sense of slip	strike slip
Rupture top (km)	0
Rupture bottom (km)	17
Rake (degrees)	180
Length (km)	89

MODEL VALUES		
Slip Rate	n/a	
Probability of activity	1	
	ELLSWORTH	HANKS
Minimum magnitude	6.5	6.5
Maximum magnitude	7.47	7.44
b-value	0.8	0.8

Fault Model	Deformation	Char Rate[1]	GR-a-	Weight

	Model		value[1]	
Moment Balanced	2.1	4.81e-04 / 4.81e-04	NA / NA	0.25
Moment Balanced	2.2	4.81e-04 / 4.81e-04	NA / NA	0.10
Moment Balanced	2.3	4.81e-04 / 4.81e-04	NA / NA	0.15

[1] 1st Value is based on Ellsworth relation and 2nd value is based on Hanks and Bakun relation

Ground Motion Interpolator

Ground Motion Interpolator (2008)

Longitude: -117.185322

Latitude: 34.057742

Site Condition (VS30): 270 (180-1050 m/sec)

Return Period:

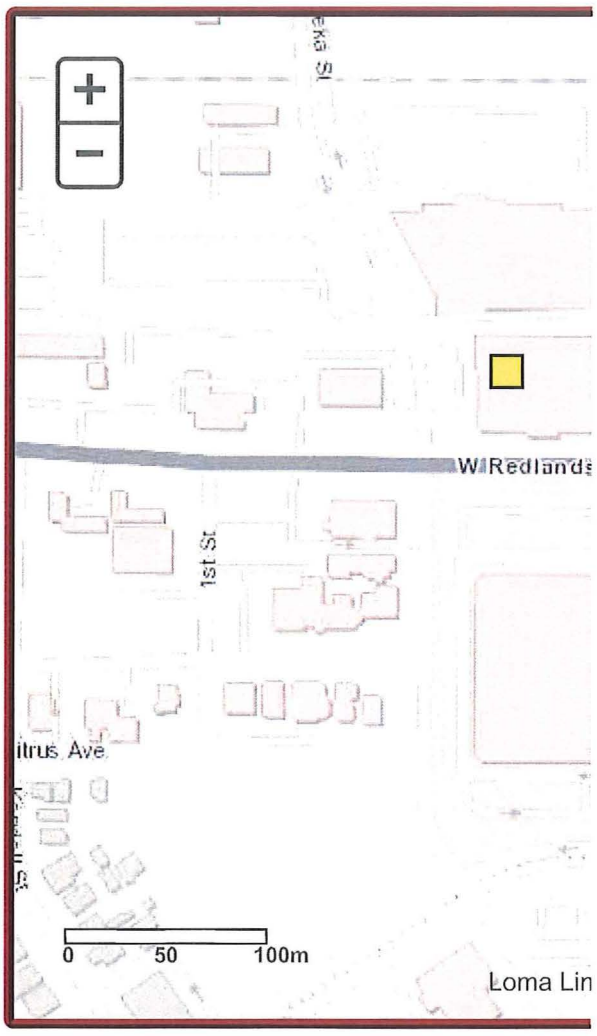
2% in 50 years 10% in 50 years

Spectral Acceleration:

PGA 0.2 second SA 1.0 second SA

Submit

Inputs:	Result:
-117.185322, 34.057742 vs30: 270 m/sec 10% in 50 years PGA	**0.632 g**



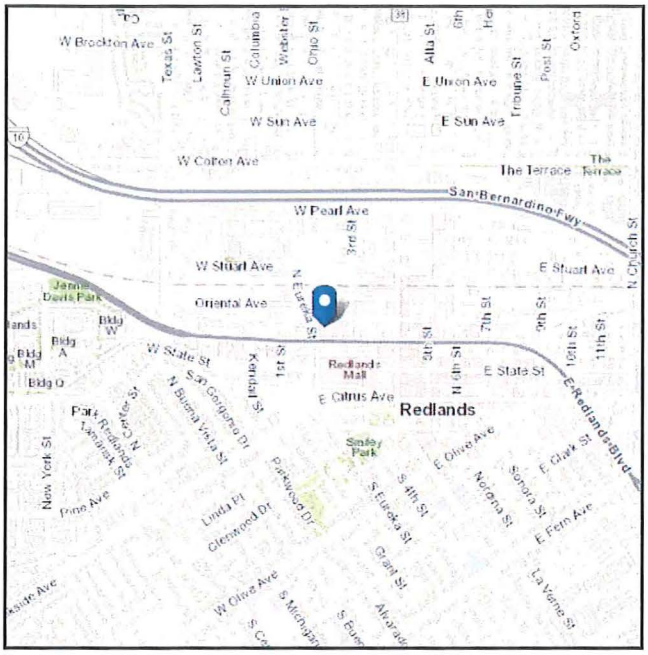
Information and Disclaimer

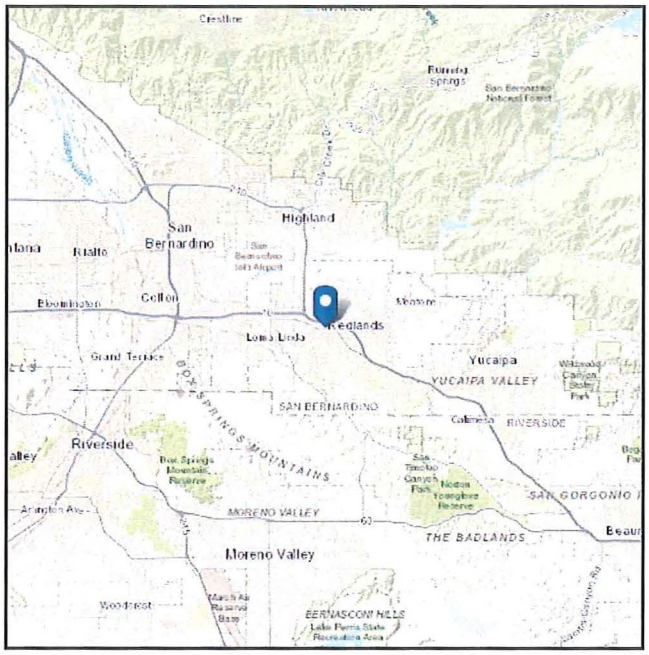
ASCE 7 Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-16
Risk Category: IV
Soil Class: D - Stiff Soil

Elevation: 1342.64 ft (NAVD 88)
Latitude: 34.057742
Longitude: -117.185322





ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

Seismic

Site Soil Class: D - Stiff Soil

Results:

S_S :	1.739	S_{D1} :	N/A
S_1 :	0.699	T_L :	8
F_a :	1	PGA :	0.743
F_v :	N/A	PGA_M :	0.818
S_{MS} :	1.739	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1.5
S_{DS} :	1.159	C_v :	1.448

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Mon May 16 2022

Date Source: USGS Seismic Design Maps

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.

In absence of detailed development, the recommendations provided shall be considered "'preliminary", subject to revision following grading and development plan review. 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 Geotechnical Engineer and designs adjusted as considered appropriate.

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.

In absence of project details, the recommendations included should be considered as "tentative', subject to verification following grading and development plan review. The tentative recommendations included 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 and development plan review when prepared, and
viii. Consultations as required during construction or upon your request.

In the event that the above conditions are not fulfilled, Soils Southwest, Inc. will assume no responsibility for any structural distresses during the lifetime use of the development planned.