

Appendix D

Geotechnical Investigation

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UPDATED GEOTECHNICAL REPORT
PROPOSED SINGLE- AND MULTI-FAMILY RESIDENTIAL DEVELOPMENTS
CATAVINA PROJECT
38105 PORTOLA AVENUE
PALM DESERT, RIVERSIDE COUNTY, CALIFORNIA

PREPARED FOR

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September 10, 2024
Project No. 4038-CR

Blue Fern West, LLC

18300 Redmond Way, Suite 120
Redmond, Washington 98052

Attention: Mr. Shane Bouchard

Subject: **Updated Geotechnical Report**
Proposed Single- and Multi-Family Residential Developments
Catavina Project
38105 Portola Avenue
Palm Desert, Riverside County, California

Dear Mr. Bouchard:

GeoTek, Inc. (GeoTek) is pleased to provide the results of this Updated Geotechnical Report for the subject project located at 38105 Portola Avenue, in the City of Palm Desert, Riverside County, California. This report presents a discussion of GeoTek's evaluation and provides preliminary geotechnical recommendations for site preparation, foundation design and construction of the proposed site improvements.

Based on the results of this evaluation, development of the property appears feasible from a geotechnical viewpoint provided that the recommendations presented in this report and in future reports are incorporated into design and construction.

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

Respectfully submitted,
GeoTek, Inc.



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Figure I – Site Location and Topography Map

Appendix A – Test Location Map; Logs of Exploratory Borings; and Laboratory Test Results
(Earth Systems Southwest, 2015a)

Appendix B – General Earthwork Grading Guidelines

I. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the geotechnical engineering and geologic conditions of the subject site as related to the currently proposed development. Services provided for this study included the following:

- Research and review of available geologic and geotechnical data and general information pertinent to the site,
- Review of geotechnical reports previously prepared for this site by Earth Systems Southwest (2015a and 2015b),
- Performance of a site reconnaissance,
- Review and evaluation of site seismicity and geologic hazards, and
- Compilation of this Updated Geotechnical Report which presents GeoTek's findings and a general summary of pertinent geotechnical conditions relevant for site development.

The intent of this report is to aid in the evaluation of the site for future development from a geotechnical perspective. The professional opinions and geotechnical information contained in this report will likely need to be updated based on review of final site development plans. These should be provided to GeoTek for review when available.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The approximately 79.12-acre rectangular shaped project site is located at 38105 Portola Avenue, in the City of Palm Desert, Riverside County, California (see Figure 1). The site is currently occupied by an abandoned golf course and associated improvements. A clubhouse, a storage warehouse building and a parking area occupy the east central portion of the site. A vehicle maintenance building, a storage equipment building, and two cell towers are located on the southeast corner of the site. A restroom building and a pump house are located in the central portion of the site. A water well is understood to be associated with the pump house. There are two large, dry ponds located in the northern and central sections of the site, and

several concrete-paved cart paths traverse the site. Power lines extend along the eastern boundary of the site in a north-south direction. The site can be identified as Riverside County Assessor's Parcel Number (APN) 620-170-009.

Topographically, the site can be considered as having relatively flat terrain. Site drainage is generally directed to the south. Site elevations vary from about 270 to 285 feet above mean sea level.

The site is bound by Frank Sinatra Drive, followed by residential development and vacant land to the north. Vacant land, followed by Portola Avenue, Desert Willow Golf Resort Maintenance Department and The Palm Desert Golf Academy at Desert Willow Golf Resort bound the site to the east. A mobile home park and Palm Desert Green Golf Course bound the site to the west. A mobile home park bounds the site to the south.

2.2 PROPOSED DEVELOPMENT

Based upon review of a *Land Use Plan*, prepared by Danielian Associates and dated July 2022, site development for the project will consist of a mix of single- and multi-family residential developments. Other project improvements are anticipated to include two (2) parks, storm water disposal facilities, underground utilities, interior street/parking/drive areas and landscape/hardscape improvements.

It is anticipated that the residential structures will be one- to three stories in height. Conventional shallow (isolated spread and continuous wall) foundations and slabs-on-grade are anticipated. Maximum anticipated structural loads of 3.5 kips per lineal foot for continuous foundations and 100 kips for columns are anticipated. Sewage disposal will be by a public sewer.

Design cuts and fills of up to approximately five (5) feet are anticipated to be required to bring the building pads to design grades; however, grading plans were not provided to GeoTek for this review. Cut and fill slopes over five (5) feet in height are not anticipated due to the relatively flat site terrain. Perimeter/interior retaining walls are anticipated.

As site development planning progresses and plans become available, the plans should be provided to GeoTek for review and comment. Additional engineering analyses may be necessary in order to provide specific earthwork recommendations and geotechnical design parameters for actual site development.

2.3 PRIOR REPORT REVIEW

GeoTek's review of the reports provided to this firm (Earth Systems Southwest, 2015a and 2015b), is summarized below.

Geotechnical Engineering Report (Earth Systems Southwest, 2015a)

Earth Systems Southwest (ESS) issued a *Geotechnical Engineering Report* which included the subject project on February 6, 2015. The report included a triangular piece of land adjacent to and east of the golf course. This triangular piece of land is not a part of the current project site area.

ESS stated that the proposed development consisted of residential housing.

ESS stated that the scope of work for their report included exploration of the near surface soils by means of drilling and sampling eight (8) exploratory borings to depths ranging from approximately 26.5 to 51.5 feet below the existing ground surface along with laboratory testing of soil samples obtained, including in-situ moisture and density, consolidation, sieve analysis, moisture-density relationship and soil chemical analysis.

ESS stated that the near surface deposits consisted of poorly graded sand with silt (SP-SM soil types per the Unified Soil Classification System) that were generally in a loose to medium dense condition. ESS further stated that the site lies within a recognized blow sand hazard area.

ESS reported that free groundwater was not encountered in the borings to a maximum depth of approximately 51.5 feet below the ground surface.

ESS reported that the site soils have a low potential for hydrocollapse as carbonate cementation was not observed and due to the generally high relative density of the site soils.

ESS reported that based on visual observations, the site soils were observed to be granular. As such, ESS stated that the Expansion Index of the on-site soils is probably in the "Very Low" (0-20) category.

ESS reported that corrosivity testing was performed on four (4) samples of the near surface site soils. ESS stated that based on the results the site soils can be considered as "mildly corrosive" to "moderately corrosive" to buried metals and possess a "negligible" exposure to sulfate attack for concrete.

ESS reports that the historic groundwater depth for the site is below 50 feet and therefore the site liquefaction potential is very low.

ESS reported that based on analysis, the potential for seismically induced dry settlement of the soils above the groundwater table for the full soil column height (50 feet) was estimated to be 0.5 inch in Boring B-1. ESS further reported that due to the general uniformity of the soils encountered, seismic settlement was expected to occur on an aerial basis and as such the calculated differential settlement was estimated to be $\frac{1}{2}$ of the total settlement of the total soil column (0.25 inch).

ESS provided seismic design parameters for the project using a Site Class "D" and the 2013 California Building Code (CBC).

ESS recommended that in areas to be filled, the existing soils within the building pad and foundation area (including any canopies or overhangs) should be overexcavated to a minimum depth of three (3) feet below existing grade, finished grade, or a minimum of two (2) feet below the bottom of the footing, whichever was deeper. The overexcavation should extend for five (5) feet beyond the outer edge of the exterior footings and include any covered walkway area, patio areas, etc. The bottoms of the overexcavations should have an undisturbed in-place density of at least 85% relative compaction. The bottom of the approved overexcavation should then be scarified and moisture conditioned for an additional depth of three (3) feet to near optimum moisture content.

ESS recommended that for auxiliary structures such as fence or retaining walls, trash enclosures, etc., the foundation subgrade should be prepared similar to the building pad recommendations; however, the lateral extent of the overexcavation need extend to only two (2) feet beyond the exterior face of the footing.

ESS stated that for street, drive and permanent parking areas, the subgrade should be overexcavated, scarified, moisture conditioned and compacted to at least 90% relative compaction for a depth of at least 18 inches below existing grade or finish grade, whichever was deeper, with the upper one foot of subgrade compacted soil to at least 95% relative compaction.

ESS estimated the shrinkage limits to range from -5 (bulking) to 10% shrinkage with a mean shrinkage of seven (7) percent.

ESS provided preliminary conventional foundation design recommendations for the project structures.

ESS stated that the estimated total static settlement for project foundations should be less than 3/4-inch, based on footings founded on firm soils as recommended. Differential static settlement between exterior and interior bearing members was estimated to be less than 1/2 inch. Total "dry sand" differential settlement was estimated to be on the order of about 1/4 inch. Collapse differential settlement was estimated to be on the order of 0.3 inches. As such, considering both static and seismic settlement applied over a typical distance of 40 feet, ESS recommended the structural engineer design for an angular distortion of 1:480 (1 inch in 40 feet). Settlement will not result in the complete loss of soil support but would be manifested as a tilting of the structure over the applied distance.

ESS provided retaining wall recommendations for the project along with preliminary pavement design recommendations.

Report of Infiltration Testing (Earth Systems Southwest, 2015b)

ESS issued a *Report of Infiltration Testing* which included the subject project on August 21, 2015. The report included a triangular piece of land adjacent to and east of the golf course. This triangular piece of land is not a part of the current project site area.

ESS stated that two (2) infiltration testing locations were selected in the vicinity of the proposed retention basins. It should be noted that one (1) of the test locations (I-1) is outside the limits of the current project site. The other test location (I-2) appears to be located in the vicinity of the basin proposed in the southeast corner of the current project site area.

ESS stated that the excavations were dug by a rubber tire backhoe to a depth of about five (5) feet below existing grades. The field infiltration testing was performed utilizing the double-ring infiltrometer method.

ESS stated that the site soils consist predominantly of poorly graded sand with silt (SP-SM soil type).

ESS stated that the tests were performed for a period of at least three (3) hours and stopped due to consistent readings and sandy soils.

The results were reported as 17.6 inches per hour for the test located outside of the project site area (I-1) and as 14.9 inches per hour for the test located within the project site area (I-2). ESS stated that no factors of safety were applied to the rates reported.

ESS stated that due to the shallow testing performed for the evaluation, it was recommended that design level testing or construction observations be performed to confirm the soil types once the basins have been excavated.

3. FIELD EXPLORATION AND LABORATORY TESTING

3.1 PREVIOUS FIELD EXPLORATION

Field explorations were previously performed at this site by ESS (2015a and 2015b) as discussed in Section 2.3 of this report. No additional field exploration was performed by GeoTek for this Updated Geotechnical report.

The approximate locations of the prior excavations for the project (ESS) are presented on the Test Location Map prepared by ESS which is included in Appendix A of this report. The logs of the exploratory borings for the explorations performed by ESS (2015a) are also included in Appendix A of this report. The subsurface exploration program conducted by ESS (2015a) occurred on January 21, 2015, and included the excavation of eight (8) geotechnical test borings to depths between 26.5 and 51.5 feet below existing ground surface. An infiltration test pit at a depth of five (5) feet below existing ground was performed on July 24, 2015 (ESS, 2015b).

3.3 PREVIOUS LABORATORY TESTING

Laboratory testing was previously performed by ESS (2015a) for soil samples collected from the site during their prior field exploration program. Laboratory testing included in-situ moisture and density, gradation analysis, consolidation, maximum density test and corrosion potential (i.e., chloride content, sulfate content, minimum resistivity and pH tests). The results of the prior laboratory testing are presented in Appendix A of this report.

No additional laboratory testing was performed by GeoTek for this Updated Geotechnical report.

4. GEOLOGIC AND SOILS CONDITIONS

4.1 REGIONAL SETTING

The subject property is situated in the Colorado Desert geomorphic province, which is a low-lying barren desert basin that is partially below sea level. The most dominant feature within this province is the Salton Trough that is a large northwest-trending alluvial filled structural block that extends about 180 miles in length.

The Coachella Valley forms the northern portion of the Salton Trough and is underlain by a series of sediments that range from Miocene to Recent/Holocene in age. The Salton Trough is bordered by the Little San Bernardino Mountains to the northeast, foothills of the San Bernardino Mountains to the northwest, and the San Jacinto and Santa Rosa Mountains to the southwest. The San Andreas Fault system extends through the Coachella Valley in a general northwest-southeast trend.

More specific to the subject property, the site is located in an area geologically mapped to be underlain by dune sand deposits (Dibblee, T.W. and Minch, J.A., 2008).

4.2 GEOLOGIC MATERIALS

A brief description of the earth materials encountered by ESS (2015a) is presented in the following section. Based on the site reconnaissance, previous exploratory excavations and review of published geologic maps, the site is locally underlain by dune sand deposits. Localized deposits of artificial fill may be present in existing building areas and unexplored portions of the site.

4.2.1 Dune Sand Deposits

Dune sand deposits were reported to have been encountered by ESS (2015a and 2015b) throughout the site. These materials typically consisted of a poorly graded sand with silt (SM-SP soil type based on the Unified Soil Classification System).

ESS reported that based on visual observations, the site soils were observed to be granular. As such, ESS stated that the Expansion Index of the site soils was probably in the "Very Low" (0-20) category. Based on the laboratory test results, the near surface materials have a soluble sulfate content of less than 0.1 percent (ASTM D 4327). The soluble sulfate content test results are provided in Appendix A of this report.

4.3 SURFACE WATER AND GROUNDWATER

4.3.1 Surface Water

If encountered during earthwork construction, surface water on this site will likely be the result of precipitation or possibly some minor surface run-off from immediately surrounding properties. Overall site area drainage is to the south, as directed by site topography. Provisions for surface drainage will need to be accounted for by the project civil engineer.

4.3.2 Groundwater

Groundwater/seepage was not encountered by ESS during the subsurface exploration (ESS, 2015a). Groundwater is anticipated to be greater than 50 feet below the ground surface. It is possible that seepage may be encountered following periods of heavy and/or prolonged precipitation.

Based on review of the California Department of Water Resources Water Data Library, it is estimated that historical groundwater levels are greater than 50 feet below the ground surface.

Based on the results of the field exploration, review of site area geomorphology and geology, groundwater/seepage will likely not be encountered during excavation and grading operations. If groundwater/seepage is encountered during construction, it is anticipated that the water can be effectively managed within shallow excavations with the use of lined sump pumps placed in the bottom of excavations or other drainage devices.

4.4 FAULTING AND SEISMICITY

The geologic structure of the entire southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is in a seismically active region. The site is not located within an “Alquist-Priolo” Earthquake Fault Zone; nor is the site mapped within a State of California Seismic Hazard Zone for liquefaction or earthquake induced landslides.

Riverside County has designated the site as “not in a fault zone” and “not in a fault line”.

4.4.1 Seismic Design Parameters

The site is located at approximately 33.7685 degrees West Latitude and -116.3759 degrees North Longitude. Due to the relatively dense nature of the site soil (average blow counts

greater than 15) a Site Class “D” is considered appropriate for this site. Site spectral accelerations (S_a and S_1) for 0.2 and 1.0 second periods for a Class “D” site, was determined from the SEAOC/OSHPD web interface that utilizes the USGS web services and retrieves the seismic design data and presents that information in a report format. Using the ASCE 7-16 option on the SEAOC/OSHPD website results in the values for S_{M1} and S_{D1} reported as “null-See Section 11.4.8” (of ASCE 7-16). As noted in ASCE 7-16, Section 11.4.8, a site-specific ground motion procedure is recommended for Site Class D when the value S_1 exceeds 0.2. The value S_1 for the subject site exceeds 0.2.

The results, based on the 2015 NEHRP and the 2022 CBC, are presented in the following table. If the exception is deemed not appropriate, a site-specific ground motion analysis will be required.

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_s	1.634g
Mapped 1.0 sec Period Spectral Acceleration, S_1	0.674g
Site Coefficient for Site Class “D”, F_a	1.0
Site Coefficient for Site Class “D”, F_v	1.7
Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, S_{MS}	1.634g
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, S_{M1}	1.719g*
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	1.09g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	1.146g*
Peak Ground Acceleration (PGA_M)	0.785g
Seismic Design Category	D

* Modified in accordance with ASCE Standard 7-16 Supplement 3 effective November 5, 2021.

Final selection of the appropriate seismic design coefficients should be made by the project structural engineer based upon the local practices and ordinances, expected building response and desired level of conservatism.

4.4.2 Liquefaction & Seismic Settlements

Liquefaction describes a phenomenon in which cyclic stresses, produced by earthquake-induced ground motion, create excess pore pressures in relatively cohesionless soils. These soils may thereby acquire a high degree of mobility, which can lead to lateral movement, sliding, consolidation and settlement of loose sediments, sand boils and other damaging deformations. This phenomenon occurs only below the water table, but, after liquefaction has

developed, the effects can propagate upward into overlying non-saturated soil as excess pore water dissipates.

The factors known to influence liquefaction potential include soil type and grain size, relative density, groundwater level, confining pressures, and both intensity and duration of ground shaking. In general, materials that are susceptible to liquefaction are loose, saturated granular soils having low fines content under low confining pressures.

Riverside County has designated the site as having a “moderate” liquefaction potential (RCIT Map My County, 2023). Due to the presence of relatively dense dune sand deposits and lack of shallow groundwater, it is GeoTek’s opinion that the potential for liquefaction and seismic induced (“dry sand”) settlement at this site is very low.

4.4.3 Other Seismic Hazards

The potential for secondary seismic hazards such as seiche and tsunami is considered to be remote due to site elevation and distance from an open body of water. Due to the absence of a nearby free-face and the very low liquefaction hazard, the potential for lateral spreading is considered to be nil.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

Development of the site appears feasible from a geotechnical viewpoint. The specific recommendations for site development provided in this report will need to be further evaluated when development plans are provided for review. The following sections present general recommendations. More specific geotechnical recommendations for site development can be provided when more finalized site development plans are available for review.

5.2 EARTHWORK CONSIDERATIONS

5.2.1 General

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the City of Palm Desert, the 2022 California Building Code (CBC) and recommendations contained in this report. The General Grading Guidelines included in Appendix B outline general procedures and do not anticipate all site-specific situations. In the

event of conflict, the recommendations presented in the text of this report should supersede those contained in Appendix B.

5.2.2 Site Clearing and Demolition

Initial site preparation should commence with removal of structures, foundations, slabs, debris, pavements, underground utilities, deleterious materials and vegetation within the limits of the planned improvements. Existing utilities, not planned for re-use, should be capped off at the property boundaries and removed. Any existing water wells, if not to be used, should be abandoned in accordance with Riverside County guidelines. All materials generated by demolition and site clearing operations should be properly disposed of off-site. Voids resulting from removing any materials should be replaced with engineered fill materials with expansion characteristics similar to the onsite materials.

5.2.3 Remedial Grading

Any undocumented fill encountered during the earthwork construction and the upper three (3) feet of native soils should be removed beneath the planned building footprints to expose competent native sand dune deposits for all areas to receive new fill and/or surface improvements. Competent materials are considered to be undisturbed sand dune deposits with a minimum of 85 percent relative compaction (ASTM D1557). The lateral extent of the recommended overexcavation should extend at least five (5) feet beyond the building limits, where obtainable.

The actual depths of removals should be determined by a GeoTek representative during site grading based on actual soil conditions encountered. Deeper removals may be required based on site demolition requirements and other factors. Remedial excavations should be taken to a relatively level bottom across individual building pads. The bottoms of all remedial excavations should be reviewed and approved by a GeoTek representative.

For removal bottoms, the exposed soils should be scarified to a depth of about twelve (12) inches, be moisture treated to slightly above the soil's optimum moisture content (ASTM D1557) and then be compacted to at least 90% of the soil's maximum dry density (ASTM D1557).

Testing by GeoTek is recommended to document that the engineered fill soils have been properly moisture conditioned and compacted as recommended.

For proposed pavement and hardscape construction, existing ground surfaces should be overexcavated to a minimum depth of 12 inches below the existing ground surface or 12 inches below the proposed subgrade elevations, whichever is deeper, and replaced as engineered fill.

5.2.4 Transition Lots and Cut Lots

Rough grading will create cut, cut/fill transition and shallow fill lots. All lots should be overexcavated such that all building pads are underlain by at least three (3) feet of compacted engineered fill and overexcavation bottoms should slope to drain to the adjacent street or suitable direction so ponding of water is not likely to occur. The lateral extent of this recommendation should include the area extending at least five (5) feet beyond the building limits.

Transition (i.e., cut/fill) lots should be overexcavated a minimum of three (3) feet below proposed grades or to a depth of 1/3 the maximum fill thickness.

All cut lots should be overexcavated to a depth of three (3) feet below proposed grade and replaced with engineered fill.

5.2.5 Engineered Fill

The on-site soils are generally considered suitable for reuse as engineered fill provided they are free from vegetation, debris, oversized materials and other deleterious material.

The undercut areas should be brought to final subgrade elevations with fill materials that are placed and compacted in general accordance with minimum project standards. Engineered fill should be placed in six-inch to eight-inch loose lifts, moisture conditioned to at least the optimum moisture content and compacted to a minimum relative compaction of 90 percent as determined by ASTM D1557 test procedures.

5.2.6 Excavation Characteristics

Excavations in the dune sand deposits should be readily accomplished with heavy-duty earthmoving or excavating equipment in good operating condition.

5.2.7 Trench Excavations and Backfill

Temporary trench excavations within the on-site materials should be stable at 1.5:1 inclinations for short durations during construction and where cuts do not exceed 15 feet in height. It is anticipated that temporary cuts to a maximum height of four (4) feet can be excavated vertically.

Trench excavations should conform to Cal-OSHA regulations. The contractor should have a competent person, per OSHA requirements, on site during construction to observe conditions and to make the appropriate recommendations.

Utility trench backfill should be compacted to at least 90 percent relative compaction (as determined by ASTM D 1557 test procedures). Under-slab trenches should also be compacted to project specifications. Where applicable, based on jurisdictional requirements, the top 12 inches of backfill below subgrade for road pavements should be compacted to at least 95 percent relative compaction. On-site materials may not be suitable for use as bedding material but should be suitable as backfill provided particles larger than six (6) inches are removed.

Compaction should be achieved with a mechanical compaction device. Ponding or jetting of trench backfill is not recommended. If backfill soils have dried out, they should be properly moisture conditioned prior to placement in trenches.

5.2.8 Shrinkage and Bulking

For planning purposes, a shrinkage factor of about 10 to 15 percent may be considered for removal of any undocumented fill and dune sand deposits that are removed and replaced as engineered fill.

A subsidence loss of up to approximately 0.1 foot is estimated for the site.

Site balance areas should be available in order to adjust project grades, depending on actual field conditions at the conclusion of earthwork construction.

Losses due to site demolition and utility line removal/relocation are not included in the above estimates and should be accounted for in earthwork balancing calculations.

5.3 DESIGN RECOMMENDATIONS

5.3.1 Foundation Design Criteria

Foundation design criteria for a conventional foundation system, in general conformance with the 2022 CBC, are presented below for the proposed residential structures associated with the project. The graded site soils are anticipated to have a “Very Low” (0-20) expansion index (EI) in accordance with ASTM D 4829. Typical design criteria for the site based upon a “Very Low” expansion index are tabulated below. These are minimal recommendations and are not intended to supersede the design by the project structural engineer.

The conventional foundation elements for the proposed buildings should bear entirely in engineered fill soils or dune sand deposits (not a combination of the two). Foundations should be designed in accordance with the 2022 CBC.

Expansion index and soluble sulfate testing of the soils should be performed during construction to evaluate the as-graded conditions. Final recommendations should be based upon the actual as-graded soils conditions.

A summary of the foundation design recommendations is presented in the following table:

GEOTECHNICAL RECOMMENDATIONS FOR FOUNDATION DESIGN

Design Parameter	“Very Low” Expansion Index
Minimum Foundation Depth (inches below lowest adjacent grade)	12 – One- and two-stories 18 – Three-stories
Minimum Foundation Width (Inches)*	12 – One- and two-stories 18 – Three-stories
Minimum Slab Thickness (actual) ¹	4 – Actual
Minimum Slab Reinforcing	6" x 6" – W1.4 x W1.4 welded wire fabric placed in middle of slab or No. 3 bars at 24-inch centers placed in middle of slab
Minimum Footing Reinforcement	Two No. 4 reinforcing bars, one placed near the top and one near the bottom
Presaturation of Subgrade Soil (Percent of Optimum)	Minimum of 100% of the optimum moisture content to a depth of at least 12 inches prior to placing concrete

*Code minimums per Table 1809.7 of the 2022 CBC should be complied with.

- 5.3.1.1 An allowable soil bearing capacity of 1,500 pounds per square foot (psf) may be used for design of continuous and perimeter footings 12 inches deep and 12 inches wide, and pad footings 24 inches square and 12 inches deep. Additionally, an increase of one-third may be applied when considering short-term live loads (e.g., seismic and wind loads). This bearing capacity contains a minimum factor of safety of three (3).
- 5.3.1.2 Based on the recommended site grading, it is estimated a total static settlement of less than one (1) inch will occur. A differential static settlement of about ½ inch over a 40-foot span is also estimated.
- 5.3.1.3 The passive earth pressure may be computed as an equivalent fluid having a density of 350 psf per foot of depth, to a maximum earth pressure of 1,500 psf for footings founded on engineered fill. The allowable passive earth pressure contains a factor of safety of 1.5. An allowable coefficient of friction between soil and concrete of 0.35 may be used with dead load forces. The coefficient of friction contains a reduction value of one-third. Passive pressure and frictional resistance can be combined without reduction. The upper one (1) foot of soil should be ignored in the passive pressure calculations unless the surface is covered with pavement.

- 5.3.1.4 A grade beam, a minimum of 12 inches wide and 12 inches deep, should be utilized across large entrances. The base of the grade beam should be at the same elevation as the bottom of the adjoining footings.
- 5.3.1.5 Where the building slab is to be designed as a beam on an elastic foundation, a modulus of subgrade reaction (k-value) of 200 pounds per cubic inch (pci) may be considered for design methodology.
- 5.3.1.6 GeoTek recommends that control joints in slabs be placed in two directions spaced approximately 24 to 36 times the thickness of the slab in inches. These joints are a widely accepted means to control cracks and should be reviewed by the project structural engineer.

5.3.2 Moisture and Vapor Retarding System

- 5.3.2.1 A moisture and vapor retarding system should be placed below slabs-on-grade where moisture migration through the slab is undesirable. Guidelines for these are provided in the 2022 California Green Building Standards Code (CALGreen) Section 4.505.2, the 2022 CBC Section 1907.1 and ACI 360R-10. The vapor retarder design and construction should also meet the requirements of ASTM E 1643. A portion of the vapor retarder design should be the implementation of a moisture vapor retardant membrane.

It should be realized that the effectiveness of the vapor retarding membrane can be adversely impacted as a result of construction related punctures (e.g., stake penetrations, tears, punctures from walking on the vapor retarder placed atop the underlying aggregate layer, etc.). These occurrences should be limited as much as possible during construction. Thicker membranes are generally more resistant to accidental puncture than thinner ones. Products specifically designed for use as moisture/vapor retarders may also be more puncture resistant. Although the CBC specifies a 6-mil vapor retarder membrane, it is GeoTek's opinion that a minimum 10 mil thick membrane with joints properly overlapped and sealed should be considered, unless otherwise specified by the slab design professional. The membrane should consist of Stego wrap or the equivalent.

Moisture and vapor retarding systems are intended to provide a certain level of resistance to vapor and moisture transmission through the concrete, but do not eliminate it. The acceptable level of moisture transmission through the slab is to a large extent based on the type of flooring used and environmental conditions.

Ultimately, the vapor retarding system should be comprised of suitable elements to limit migration of water and reduce transmission of water vapor through the slab to acceptable levels. The selected elements should have suitable properties (i.e. thickness, composition, strength, and permeability) to achieve the desired performance level.

Moisture retarders can reduce, but not eliminate, moisture vapor rise from the underlying soils up through the slab. Moisture retarder systems should be designed and constructed in accordance with applicable American Concrete Institute, Portland Cement Association, ASTM, CALGreen and California Building Code requirements and guidelines.

GeoTek recommends that a qualified person, such as the flooring contractor, structural engineer, architect, and/or other experts specializing in moisture control within the building be consulted to evaluate the general and specific moisture and vapor transmission paths and associated potential impact on the proposed construction. That person (or persons) should provide recommendations relative to the slab moisture and vapor retarder systems and for migration of potential adverse impact of moisture vapor transmission on various components of the structures, as deemed appropriate.

In addition, the recommendations in this report and GeoTek's services in general are not intended to address mold prevention; since GeoTek, along with geotechnical consultants in general, do not practice in the area of mold prevention. If specific recommendations addressing potential mold issues are desired, then a professional mold prevention consultant should be contacted.

5.3.3 Miscellaneous Foundation Recommendations

- 5.3.3.1 To minimize moisture penetration beneath the slab-on-grade areas, utility trenches should be backfilled with engineered fill, lean concrete or concrete slurry where they intercept the perimeter footing or thickened slab edge.

5.3.3.2 Soils from the footing excavations should not be placed in the slab-on-grade areas unless properly compacted and tested. The excavations should be free of loose/sloughed materials and be neatly trimmed at the time of concrete placement.

5.3.4 Foundation Setbacks

Where applicable, the following setbacks should apply to all foundations. Any improvements not conforming to these setbacks may be subject to lateral movements and/or differential settlements:

- The outside bottom edge of all footings should be set back a minimum of $H/3$ (where H is the slope height) from the face of any descending slope. The setback should be at least seven (7) feet and need not exceed 40 feet.
- The bottom of all footings for structures near retaining walls should be deepened so as to extend below a 1:1 projection upward from the bottom inside edge of the wall stem. This applies to the existing retaining walls along the perimeter if they are to remain.
- The bottom of any proposed foundations for structures should be deepened so as to extend below a 1:1 projection upward from the bottom of the nearest excavation.

5.4 RETAINING WALL DESIGN AND CONSTRUCTION

5.4.1 General Design Criteria

Retaining wall foundations embedded a minimum of 12 inches into engineered fill or competent bedrock should be designed using an allowable bearing capacity of 2,500 psf. An increase of one-third may be applied when considering short-term live loads (e.g., seismic and wind loads).

The passive earth pressure may be computed as an equivalent fluid having a density of 350 psf per foot of depth, to a maximum earth pressure of 1,500 psf. A coefficient of friction between soil and concrete of 0.35 may be used with dead load forces. Passive pressure and frictional resistance can be combined without reduction.

An equivalent fluid pressure approach may be used to compute the horizontal active pressure against the wall. The appropriate fluid unit weights are given in the table below for specific slope gradients of retained materials.

Surface Slope of Retained Materials (H:V)	Equivalent Fluid Pressure (PCF) Select Backfill*
Level	35
2:1	50

*Select backfill should consist of approved materials with an expansion index less than or equal to 20.

For walls with a retained height greater than six (6) feet, an incremental seismic pressure should be included into the wall design. Where needed, it is recommended that an equivalent fluid pressure of 15 psf be included in the wall design to account for seismic loading conditions. This pressure may be applied as a standard triangular distribution.

5.4.2 Restrained Retaining Walls

Any retaining wall that will be restrained prior to placing backfill or walls that have male or reentrant corners should be designed for at-rest soil conditions using an equivalent fluid pressure of 55 pcf (select backfill), plus any applicable surcharge loading. For areas having male or reentrant corners, the restrained wall design should extend a minimum distance equal to twice the height of the wall laterally from the corner, or as otherwise determined by the structural engineer.

5.4.2.1 Other Design Considerations

- Retaining and garden wall foundation elements should be designed in accordance with building code setback requirements. A minimum horizontal setback distance of five (5) feet as measured from the bottom outside edge of the footing to a sloped face is recommended.
- Wall design should consider the additional surcharge loads from superjacent slopes and/or footings, where appropriate.
- No backfill should be placed against concrete until minimum design strengths are evident by compression tests of cylinders.
- The retaining wall footing excavations, backcuts and backfill materials should be approved by the project geotechnical engineer or their authorized representative.
- Positive separations should be provided in garden walls at horizontal distances not exceeding 20 feet.

5.4.3 Soil Corrosivity

The soil resistivity at this site was tested in the laboratory on four (4) samples collected during the previous field investigation conducted (ESS, 2015a). The results of the testing indicate that the on-site soils are considered “moderately corrosive” to “corrosive” (3,704 to 6,579 ohm-

cm) (Roberge, 2000) to buried ferrous metal in accordance with current standards used by corrosion engineers. Recommendations for protection of buried ferrous metal should be provided by a corrosion engineer. Additional corrosion testing should be performed at the time of site grading to assess the corrosion potential of the as-graded soils.

5.4.4 Soil Sulfate Content

The sulfate content was determined in the laboratory on four (4) samples collected during the previous field investigation conducted (ESS, 2015a). The results indicate that the water-soluble sulfate result is less than 0.1 percent by weight, which is considered “negligible” as per Table 19.3.1.1 of ACI 318-19. Based on the test results and Table 19.3.1.1 of ACI 318-19, no special recommendations for concrete are required for this project due to soil sulfate exposure.

5.4.5 Import Soils

Import soils should have expansion characteristics similar to the on-site soils. GeoTek also recommends that the proposed import soils be tested for expansion and sulfate potential. GeoTek should be notified a minimum of 72 hours prior to importing so that appropriate sampling and laboratory testing can be performed.

5.5 PAVEMENT DESIGN CONSIDERATIONS

Pavement design for proposed on-site pavement (i.e., local, collector and secondary roadways) improvements was conducted per Caltrans *Highway Design Manual* guidelines for flexible pavements. An R-value of 40 is being estimated for the post-graded roadway subgrade soils. For preliminary pavement design, assumed Traffic Indexes (TI) of 5.0 and 7.0 were used. Final pavement design should be based on R-value testing of the graded street subgrades and the assigned TI values. Based on the assumptions noted, the following preliminary pavement design recommendations are provided.

TI	Thickness of Asphalt Concrete (inches)	Thickness of Aggregate Base (inches)
5.0 (General Local)	3.0	4.0
7.0 (Collector/Enhanced Local)	4.0	7.0

The TIs used in the pavement design are typically considered reasonable values for the proposed street/parking/drive areas and should provide a pavement life of approximately 20 years with a normal amount of flexible pavement maintenance. Irrigation adjacent to pavements, without a deep curb or other cutoff to separate landscaping from the paving may

result in premature pavement failure. Traffic parameters used for design were selected based upon engineering judgment and not upon information furnished to us such as an equivalent wheel load analysis or a traffic study.

The recommended pavement sections provided are intended as a minimum guideline and final selection of pavement cross section parameters should be made by the project civil engineer, based upon the local laws and ordinances, expected subgrade and pavement response, and desired level of conservatism. If thinner or highly variable pavement sections are constructed, increased maintenance and repair could be expected. Final pavement design should be checked by testing of soils exposed at subgrade (the upper 12 inches) after final grading has been completed.

Asphalt concrete and aggregate base should conform to current Caltrans Standard Specifications Section 39 and 26-1.02, respectively. As an alternative, asphalt concrete can conform to Section 203-6 of the current Standard Specifications for Public Work (Green Book). Crushed aggregate base or crushed miscellaneous base should conform to Section 200-2.2 and 200-2.4 of the Green Book, respectively. Pavement base should be compacted to at least 95 percent of the ASTM D1557 laboratory maximum dry density (modified proctor).

All pavement installation, including preparation and compaction of subgrade, compaction of base material, placement, rolling and compaction of asphaltic concrete, should be performed in accordance with the City of Palm Desert specifications, and under the observation and testing of GeoTek and a City Inspector where required. Jurisdictional minimum compaction requirements in excess of the aforementioned minimums may govern.

Deleterious material, excessive wet or dry pockets, oversized rock fragments, and other unsuitable yielding materials encountered during grading should be removed. Once existing compacted fills are brought to the proposed pavement subgrade elevations, the subgrade should be proof rolled in order to check for a uniform and unyielding surface. The upper 12 inches of pavement subgrade soils should be scarified, moisture conditioned at or near optimum moisture content, and recompacted to at least 95 percent of the laboratory maximum dry density (ASTM D1557). If loose or yielding materials are encountered during construction, additional evaluation of these areas should be carried out by GeoTek. All pavement section changes should be properly transitioned.

5.6 CONCRETE CONSTRUCTION

5.6.1 General

Concrete construction should follow the 2022 CBC and ACI guidelines regarding design, mix placement and curing of the concrete. If desired, GeoTek could provide quality control testing of the concrete during construction.

5.6.2 Concrete Flatwork

Exterior concrete slabs and sidewalks should be designed using a four-inch minimum thickness. No specific reinforcement is required from a geotechnical perspective. However, some shrinkage and cracking of the concrete should be anticipated as a result of typical mix designs and curing practices commonly utilized in industrial construction.

Sidewalks and driveways may be under the jurisdiction of the governing agency. If so, jurisdictional design and construction criteria would apply, if more restrictive than the recommendations presented in this report.

Subgrade soils should be pre-moistened prior to placing concrete. The subgrade soils below exterior slabs, sidewalks, driveways, etc. should be pre-saturated to a minimum of 100% of the optimum moisture content to a depth of 12 inches for soils having a “Very Low” expansion index.

All concrete installation, including preparation and compaction of subgrade, should be performed in accordance with the City of Palm Desert specifications, and under the observation and testing of GeoTek and a City inspector, if necessary.

5.6.3 Concrete Performance

Concrete cracks should be expected. These cracks can vary from sizes that are “hairline” to more than 1/8 inch in width. Most cracks in concrete while unsightly do not significantly impact long-term performance. While it is possible to take measures (proper concrete mix, placement, curing, control joints, etc.) to reduce the extent and size of cracks that occur, some cracking will occur despite the best efforts to minimize it. Concrete undergoes chemical processes that are dependent on a wide range of variables, which are difficult, at best, to control. Concrete, while seemingly a stable material, is subject to internal expansion and contraction due to external changes over time.

One of the simplest means to control cracking is to provide weakened control joints for cracking to occur along. These do not prevent cracks from developing; they simply provide a

relief point for the stresses that develop. These joints are a widely accepted means to control cracks but are not always effective. Control joints are more effective the more closely spaced they are. GeoTek suggests that control joints be placed in two directions and located a distance approximately equal to 24 to 36 times the slab thickness.

Exterior concrete flatwork (patios, walkways, driveways, etc.) is often some of the most visible aspects of site development. They are typically given the least level of quality control, being considered “non-structural” components. It is suggested that the same standards of care be applied to these features as to the structures themselves.

5.7 POST CONSTRUCTION CONSIDERATIONS

5.7.1 Landscape Maintenance and Planting

Water has been shown to weaken the inherent strength of soil, and slope stability is significantly reduced by overly wet conditions. Positive surface drainage away from graded slopes should be maintained and only the amount of irrigation necessary to sustain plant life should be provided for planted slopes. Controlling surface drainage and runoff and maintaining a suitable vegetation cover can minimize erosion. Plants selected for landscaping should be lightweight, deep-rooted types that require little water and are capable of surviving the prevailing climate.

Overwatering should be avoided. Care should be taken when adding soil amendments to avoid excessive watering. Leaching as a method of soil preparation prior to planting is not recommended. An abatement program to control ground-burrowing rodents should be implemented and maintained. This is critical as burrowing rodents can decrease the long-term performance of slopes.

It is common for planting to be placed adjacent to structures in planter or lawn areas. This will result in the introduction of water into the ground adjacent to the foundations. This type of landscaping should be avoided. Planters within 30 feet of the buildings should be above ground and underlain by a concrete slab. Waterproofing of the foundation and/or subdrains may be warranted and advisable. GeoTek could discuss these issues, if desired, when plans are made available.

5.7.2 Drainage

The need to maintain proper surface drainage and subsurface systems cannot be overly emphasized. Positive site drainage should be maintained at all times. Drainage should not flow

uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond or seep into the ground adjacent to the footings and floor-slabs. Pad drainage should be directed toward approved areas and not be blocked by other improvements.

Roof gutters should be installed that will direct the collected water at least 20 feet from the buildings.

It is the owner's responsibility to maintain and clean drainage devices on or contiguous to their lot. In order to be effective, maintenance should be conducted on a regular and routine schedule and necessary corrections made prior to each rainy season.

5.8 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

GeoTek recommends that site grading, specifications, retaining wall/shoring plans and foundation plans be reviewed by this office prior to construction to check for conformance with the recommendations of this report. Additional recommendations may be necessary based on these reviews. GeoTek also recommends that representatives from this firm be present during site grading and foundation construction to check for proper implementation of the geotechnical recommendations. The owner/developer should have GeoTek's representative perform at least the following duties:

- Observe site clearing and grubbing operations for proper removal of unsuitable materials.
- Observe and test bottom of removals prior to fill placement.
- Evaluate the suitability of on-site and import materials for fill placement and collect soil samples for laboratory testing when necessary.
- Observe the fill for uniformity during placement including utility trenches.
- Test the fill for field density and relative compaction.
- Test the near-surface soils to verify proper moisture content.
- Observe and probe foundation excavations to confirm suitability of bearing materials.

If requested, a construction observation and compaction report can be provided by GeoTek, which can comply with the requirements of the governmental agencies having jurisdiction over the project. GeoTek recommends that these agencies be notified prior to commencement of construction so that necessary grading permits can be obtained.

6. LIMITATIONS

This evaluation does not and should in no way be construed to encompass any areas beyond the specific area of proposed construction as indicated to us by the client. Further, no evaluation of any existing site improvements is included. The scope is based on GeoTek's understanding of the project and the client's needs, GeoTek's proposal (Proposal No. P-0809324-CR) dated August 27, 2024, and geotechnical engineering standards normally used on similar projects in this region.

The materials observed on the project site appear to be representative of the area; however, soil and bedrock materials vary in character between excavations and natural outcrops or conditions exposed during site construction. Site conditions may vary due to seasonal changes or other factors. GeoTek, Inc. assumes no responsibility or liability for work, testing or recommendations performed or provided by others.

Since GeoTek's recommendations are based on the site conditions observed and encountered, and laboratory testing, GeoTek's conclusions and recommendations are professional opinions that are limited to the extent of the available data. Observations during construction are important to allow for any change in recommendations found to be warranted. These opinions have been derived in accordance with current standards of practice and no warranty is expressed or implied. Standards of practice are subject to change with time.

7. SELECTED REFERENCES

American Society of Civil Engineers (ASCE), 2013, "Minimum Design Loads for Buildings and Other Structures," ASCE/SEI 7-10, Third Printing, Errata Incorporated through March 15.

Bowles, J. E., 1977, "Foundation Analysis and Design", Second Edition.

Bryant, W.A., and Hart, E.W., 2007, "Fault Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps," California Geological Survey: Special Publication 42.

California Code of Regulations, Title 24, 2022 "California Building Code," 2 volumes.

California Geological Survey (CGS, formerly referred to as the California Division of Mines and Geology), 1977, "Geologic Map of California."



_____, 1998, "Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada," International Conference of Building Officials.

_____, 2008, "Guidelines for Evaluating and Mitigating Seismic Hazards in California," Special Publication 117A.

_____, 2010, "Geologic Map of California".

Danielian Associates, 2022, "Land Use Plan, Catavina," dated July.

Dibblee, T.W. and Minch, J.A., 2008, Geologic Map of the Thousand Palms & Lost Horse Mountain 15-minute quadrangles, Riverside County, California, Dibblee Geological Foundation, Dibblee Foundation Map DF-372, 1:62,500.

GeoTek, Inc., In-house proprietary information.

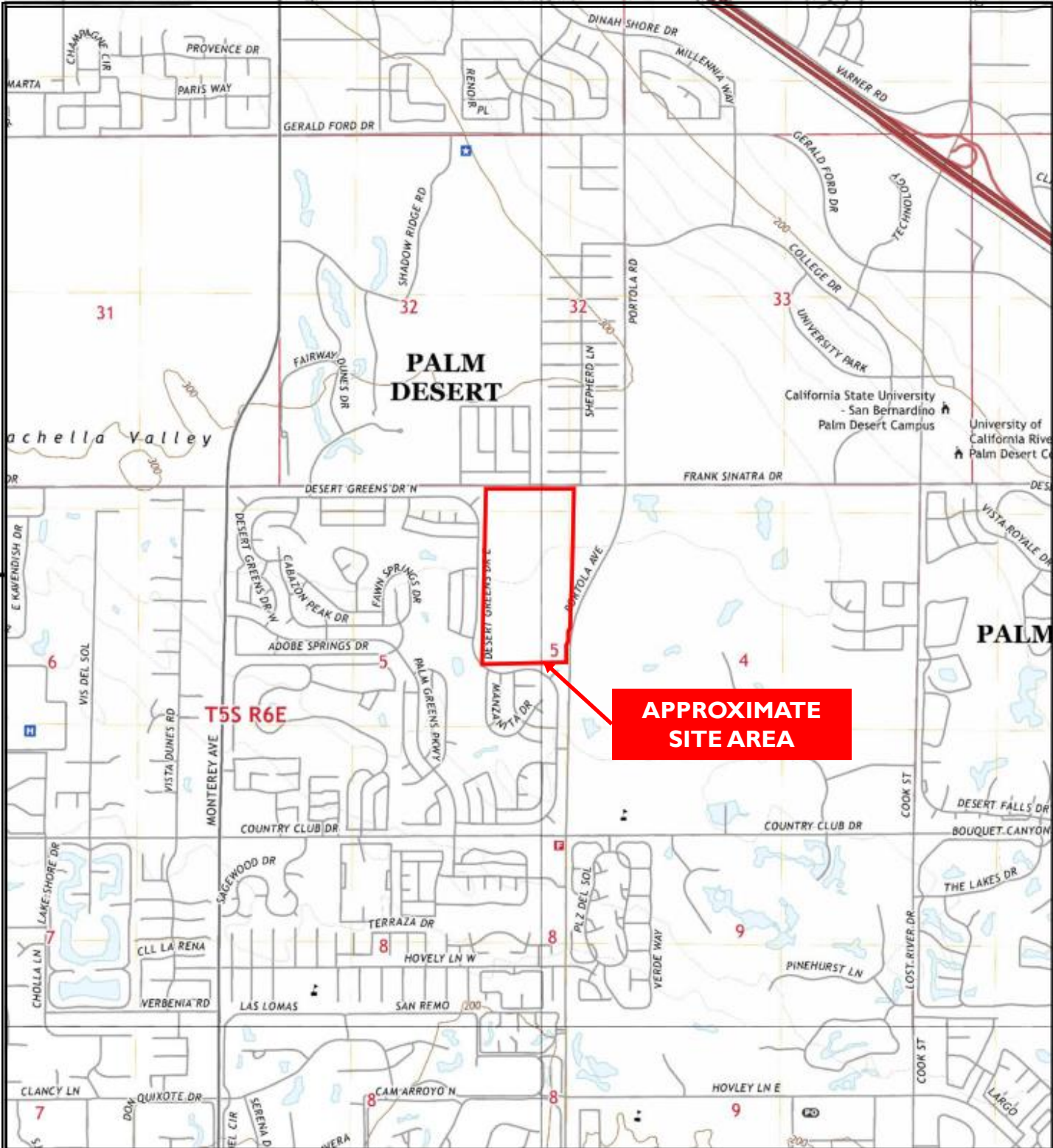
Earth Systems Southwest, 2015a, "Geotechnical Engineering Report, Proposed Catavina Residential Development, Southwest Corner of Frank Sinatra Drive and Portola Avenue, Palm Desert, Riverside County, California," File No. 12329-01, dated February 6.

_____, 2015b, "Report of Infiltration Testing, Proposed Catavina Residential Development, Southwest Corner of Frank Sinatra Drive and Portola Avenue, Palm Desert, Riverside County, California," File No. 12329-01, dated August 21.

Riverside County GIS website, "Map My County" ([Map My County v10 \(countyofriverside.us\)](http://mapmycountyofriverside.us)).

SEA/OSHPD web service, "Seismic Design Maps" (<https://seismicmaps.org>).

Terzaghi, K. and Peck, R. B., 1967, "Soil Mechanics in Engineering Practice", Second Edition.



Modified from the Cathedral City, Myoma, Rancho Mirage and La Quinta 2021 7.5-Minute Topographic Map Sheets

0 Miles 0.25 0.5 1 1.5

Blue Fern Development

Assessor's Parcel Number (APN) 620-170-009
Catavina Project
38105 Portola Avenue
Palm Desert, Riverside County, California

Project No. 4038-CR



Figure 1
Site Location
and
Topography
Map



APPENDIX A

TEST LOCATION MAP; LOGS OF EXPLORATORY BORINGS; AND LABORATORY TEST RESULTS (ESS, 2015a)

Proposed Single- and Multi-Family Residential Developments

Catavina Project

38105 Portola Avenue

Palm Desert, Riverside County, California

Project No. 4038-CR





Source: Google Earth satellite image dated 11/26/2012.

LEGEND

 I-2 **Approximate Infiltration Test Locations**

Approximate Scale: 1" = 350'

0 350' 700'



Plate 2 Test Location Map

Proposed Catavina Residential Development
 Southwest Corner of Frank Sinatra Drive and Portola Avenue
 Palm Desert, Riverside County, California



Earth Systems
Southwest

8/10/2015

File No.: 12329-01



Boring No: B-1 (2015)

Project Name Catavina Residential Development, Palm Desert, CA
Project Number: 12329-01
Boring Location: See Plate 2

Drilling Date: January 21, 2015

Drilling Method: 6" Hollow Stem Auger w/Autohammer

Drill Type: Mobile B-61

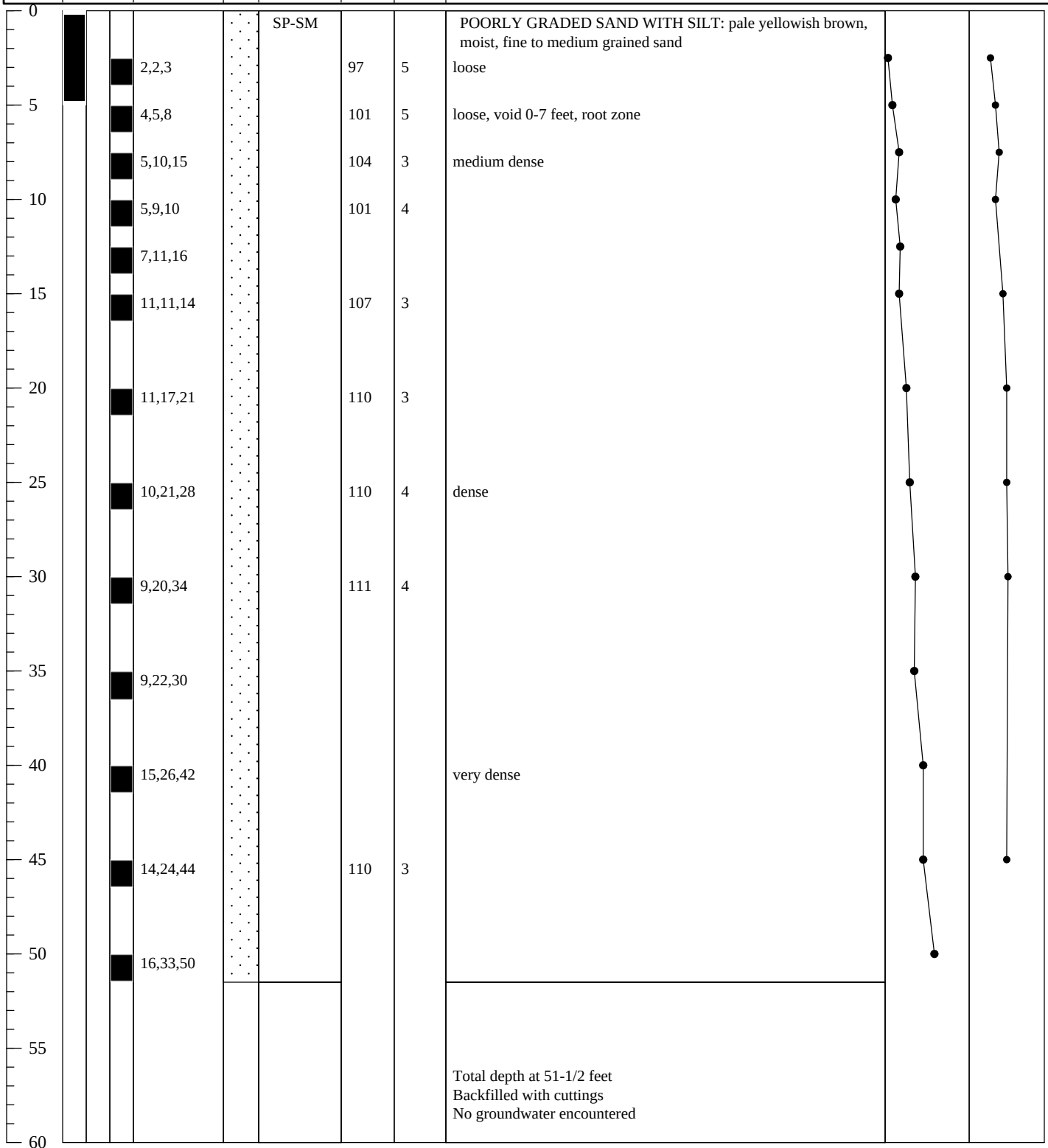
Logged By: R. Reed

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Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density





Boring No: B-2 (2015)

Project Name Catavina Residential Development, Palm Desert, CA
Project Number: 12329-01
Boring Location: See Plate 2

Drilling Date: January 21, 2015

Drilling Method: 6" Hollow Stem Auger w/Autohammer

Drill Type: Mobile B-61

Logged By: R. Reed

Depth (Ft.)	Sample Type			Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units	Graphic Trend	
	Bulk	SPT	MOD Calif.							Blow Count	Dry Density
0						SP-SM			POORLY GRADED SAND WITH SILT: pale yellowish brown, moist, medium dense, fine to medium grained sand		
10,18,22							114	4			
5							110	4			
8,15,17							107	4			
5,9,13							110	4			
5,11,13											
6,13,17											
8,14,17											
10,15,18							106	4			
10,21,26									dense		
25											
30											
35											
40											
45											
50											
55											
60									Total depth at 26-1/2 feet Backfilled with native cuttings No groundwater encountered		



Boring No: B-3 (2015)

Project Name Catavina Residential Development, Palm Desert, CA
Project Number: 12329-01
Boring Location: See Plate 2

Drilling Date: January 21, 2015

Drilling Method: 6" Hollow Stem Auger w/Autohammer

Drill Type: Mobile B-61

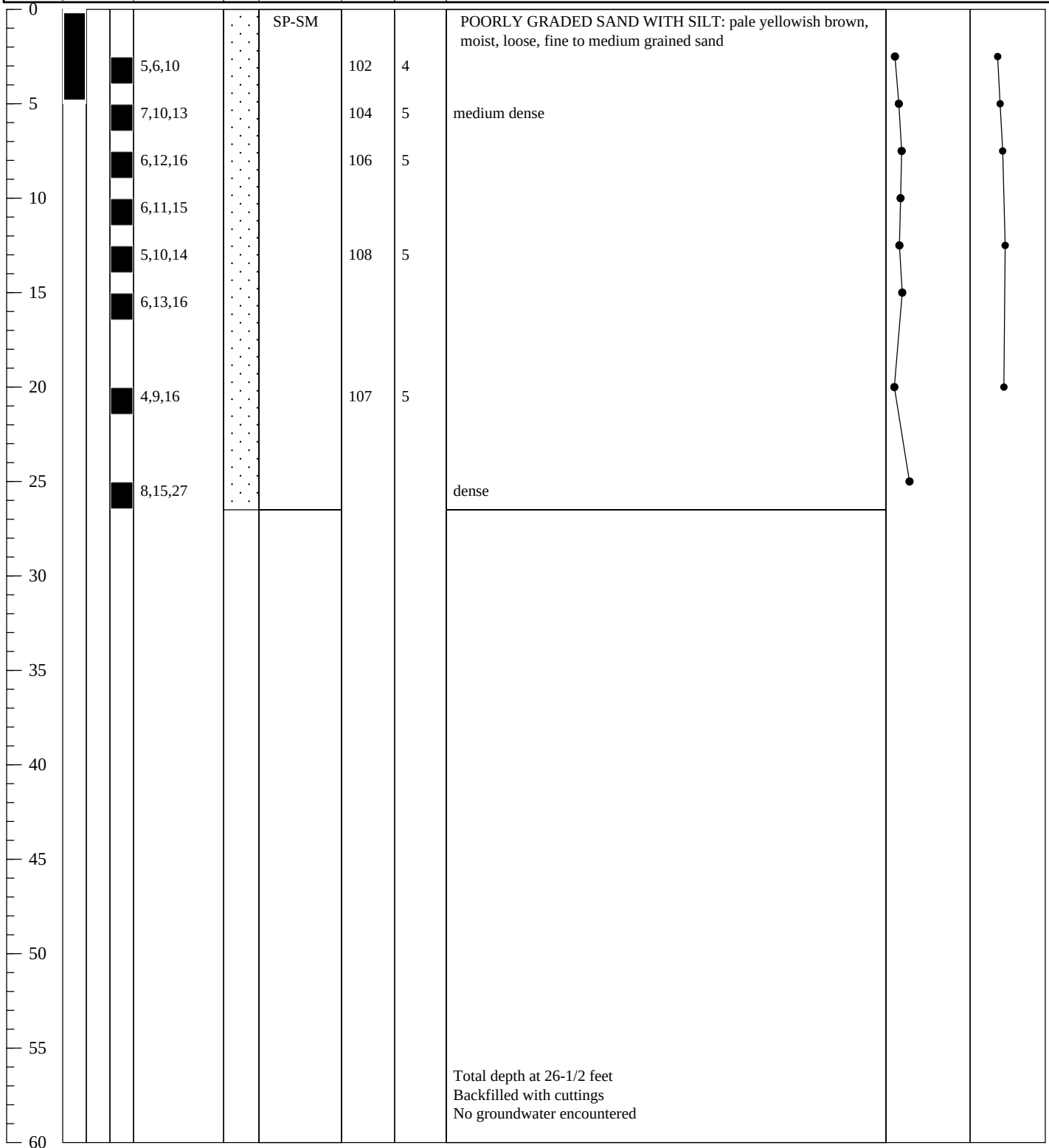
Logged By: R. Reed

Page 1 of 1

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density





Boring No: B-4 (2015)

Project Name Catavina Residential Development, Palm Desert, CA
Project Number: 12329-01
Boring Location: See Plate 2

Drilling Date: January 21, 2015

Drilling Method: 6" Hollow Stem Auger w/Autohammer

Drill Type: Mobile B-61

Logged By: R. Reed

Depth (Ft.)	Sample Type			Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.	Graphic Trend	
	Bulk	SPT	MOD Calif.							Blow Count	Dry Density
0						SP-SM			POORLY GRADED SAND WITH SILT: pale yellowish brown, moist, loose, fine to medium grained sand		
5				5,7,8			102	2			
				5,9,11			106	2	medium dense		
				6,9,14			108	3			
10				7,10,12			106	4			
				5,10,14							
15				6,12,15			111	2			
20				7,14,21							
25				7,14,18			108	3			
30											
35											
40											
45											
50											
55											
60									Total depth at 26-1/2 feet Backfilled with cuttings No groundwater encountered		



Boring No: B-5 (2015)

Project Name Catavina Residential Development, Palm Desert, CA
Project Number: 12329-01
Boring Location: See Plate 2

Drilling Date: January 21, 2015

Drilling Method: 6" Hollow Stem Auger w/Autohammer

Drill Type: Mobile B-61

Logged By: R. Reed

Depth (Ft.)	Sample Type		Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units		Graphic Trend			
	Bulk	SPT						MOD Calif.	Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.	Blow Count	Dry Density		
0			9,10,12		SP-SM	112	5	POORLY GRADED SAND WITH SILT: pale yellowish brown, moist, medium dense, fine to medium grained sand					
5											5,8,11	105	4
											4,8,10	102	4
10											6,11,14	107	5
											10,13,11		
15											11,13,22	112	4
20											6,11,18		
25	10,22,27	109	4	dense									
30													
35													
40													
45													
50													
55													
60								Total depth at 26-1/2 feet Backfilled with cuttings No groundwater encountered					



Drilling Date: January 21, 2015
Drilling Method: 6" Hollow Stem Auger w/Autohammer
Drill Type: Mobile B-61
Logged By: R. Reed

Project Name Catavina Residential Development, Palm Desert, CA
Project Number: 12329-01
Boring Location: See Plate 2

Depth (Ft.)	Sample Type		Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units		Graphic Trend	
	Bulk SPT	MOD Calif.						Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.	Blow Count	Dry Density	
0					SP-SM			POORLY GRADED SAND WITH SILT: pale yellowish brown, moist, medium dense, fine to medium grained sand			
3			6,9,10			102	5				
4			5,10,11			103	5				
5			5,9,11			105	5				
8			5,8,11			99	4				
10			5,11,15			107	4				
12			8,14,19			106	4				
20			7,13,18								
25			7,10,19								
30											
35											
40											
45											
50											
55											
60											
Total depth at 26-1/2 feet Backfilled with native cuttings No groundwater encountered											



Boring No: B-7 (2015)

Project Name Catavina Residential Development, Palm Desert, CA
Project Number: 12329-01
Boring Location: See Plate 2

Drilling Date: January 21, 2015

Drilling Method: 6" Hollow Stem Auger w/Autohammer

Drill Type: Mobile B-61

Logged By: R. Reed

Depth (Ft.)	Sample Type			Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units	Graphic Trend	
	Bulk	SPT	MOD Calif.							Blow Count	Dry Density
0						SP-SM			POORLY GRADED SAND WITH SILT: pale yellowish brown, moist, medium dense, fine to medium grained sand		
7,10,13							107	6			
7,12,16							105	5			
6,9,13							105	5			
8,5,11							100	5			
4,6,10							97	7			
8,14,21									dense		
9,17,27							113	5			
11,22,28											
26-1/2									Total depth at 26-1/2 feet Backfilled with native cuttings No groundwater encountered		



Boring No: B-8 (2015)

Project Name Catavina Residential Development, Palm Desert, CA
Project Number: 12329-01
Boring Location: See Plate 2

Drilling Date: January 21, 2015

Drilling Method: 6" Hollow Stem Auger w/Autohammer

Drill Type: Mobile B-61

Logged By: R. Reed

Depth (Ft.)	Sample Type			Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units	Graphic Trend	
	Bulk	SPT	MOD Calif.							Blow Count	Dry Density
0						SP-SM			POORLY GRADED SAND WITH SILT: pale yellowish brown, moist, loose, fine to medium grained sand		
4,6,8							99	5			
4,7,12							106	4	medium dense		
11,12,15							105	3			
7,12,16							108	3			
6,9,14											
5,10,15							108	3			
9,14,20							108	3			
9,20,27									dense		
26-1/2									Total depth at 26-1/2 feet Backfilled with native cuttings No groundwater encountered		

UNIT DENSITIES AND MOISTURE CONTENT

ASTM D2937 & D2216

Job Name: Catavina Residential Development

Sample Location	Depth (feet)	Unit Dry Density (pcf)	Moisture Content (%)	USCS Group Symbol
B1	2.5	97	5	SP-SM
B1	5	101	5	SP-SM
B1	7.5	104	3	SP-SM
B1	10	101	4	SP-SM
B1	15	107	3	SP-SM
B1	20	110	3	SP-SM
B1	25	110	4	SP-SM
B1	30	111	4	SP-SM
B1	45	111	3	SP-SM
B2	2.5	114	4	SP-SM
B2	5	110	4	SP-SM
B2	7.5	107	4	SP-SM
B2	12.5	110	4	SP-SM
B2	20	106	4	SP-SM
B3	2.5	102	4	SP-SM
B3	5	104	5	SP-SM
B3	7.5	106	5	SP-SM
B3	12.5	108	5	SP-SM
B3	20	107	5	SP-SM
B4	2.5	102	2	SP-SM
B4	5	106	2	SP-SM
B4	7.5	108	3	SP-SM
B4	10	106	4	SP-SM
B4	15	111	2	SP-SM
B4	25	108	3	SP-SM

UNIT DENSITIES AND MOISTURE CONTENT

ASTM D2937 & D2216

Job Name: Catavina Residential Development

Sample Location	Depth (feet)	Unit Dry Density (pcf)	Moisture Content (%)	USCS Group Symbol
B5	2.5	112	5	SP-SM
B5	5	105	4	SP-SM
B5	7.5	102	4	SP-SM
B5	10	107	5	SP-SM
B5	15	112	4	SP-SM
B5	25	109	4	SP-SM
B6	2.5	102	5	SP-SM
B6	5	103	5	SP-SM
B6	7.5	105	5	SP-SM
B6	10	99	4	SP-SM
B6	12.5	107	4	SP-SM
B6	15	106	4	SP-SM
B7	2.5	107	6	SP-SM
B7	5	105	5	SP-SM
B7	7.5	105	5	SP-SM
B7	10	100	5	SP-SM
B7	12.5	93	7	SP-SM
B7	20	113	5	SP-SM
B8	2.5	99	5	SP-SM
B8	5	106	4	SP-SM
B8	7.5	105	3	SP-SM
B8	10	108	3	SP-SM
B8	15	108	3	SP-SM
B8	20	108	4	SP-SM

SIEVE ANALYSIS

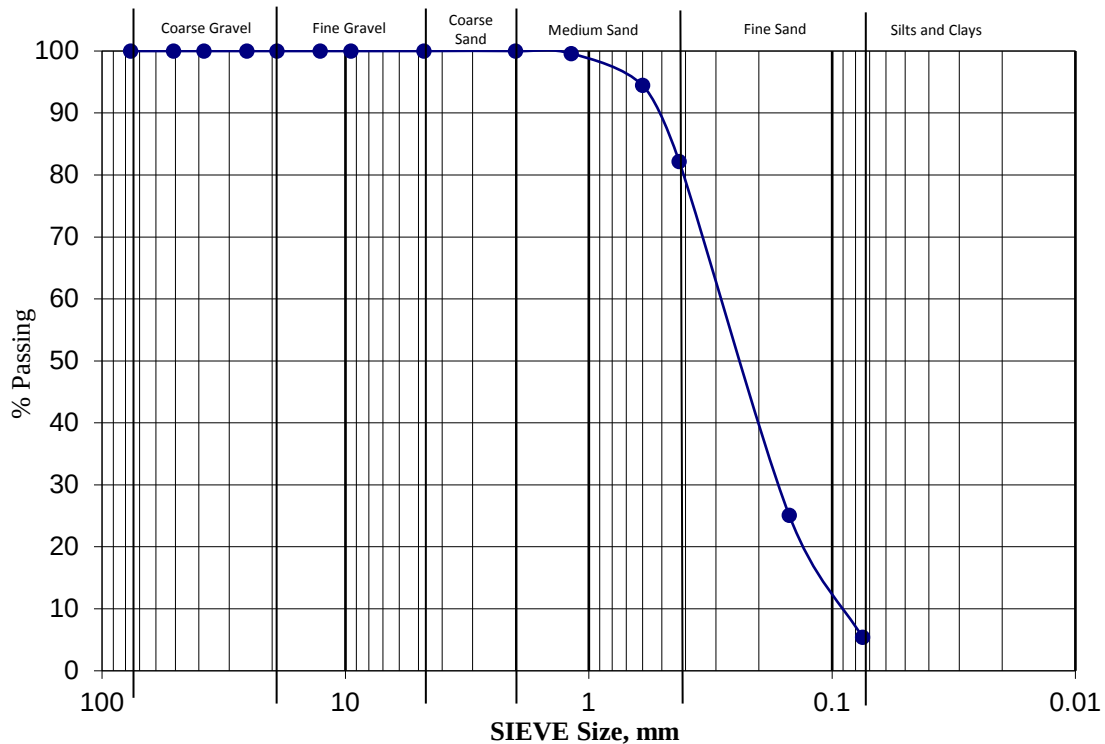
ASTM D6913

Job Name: Catavina Residential Development

Sample ID: B1 @ 0-5 feet

Description: Sand w/Silt (SP-SM)

Sieve Size	% Passing
3"	100
2"	100
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
#4	100
#10	100
#16	100
#30	94
#40	82
#100	25
#200	5.4



% Coarse Gravel: 0	% Coarse Sand: 0	Cu: 3.22 Cc: 1.08	Gradation
% Fine Gravel: 0	% Medium Sand: 18 % Fine Sand: 77		
% Total Gravel 0	% Total Sand 95	% Fines: 5	Poorly Graded

SIEVE ANALYSIS

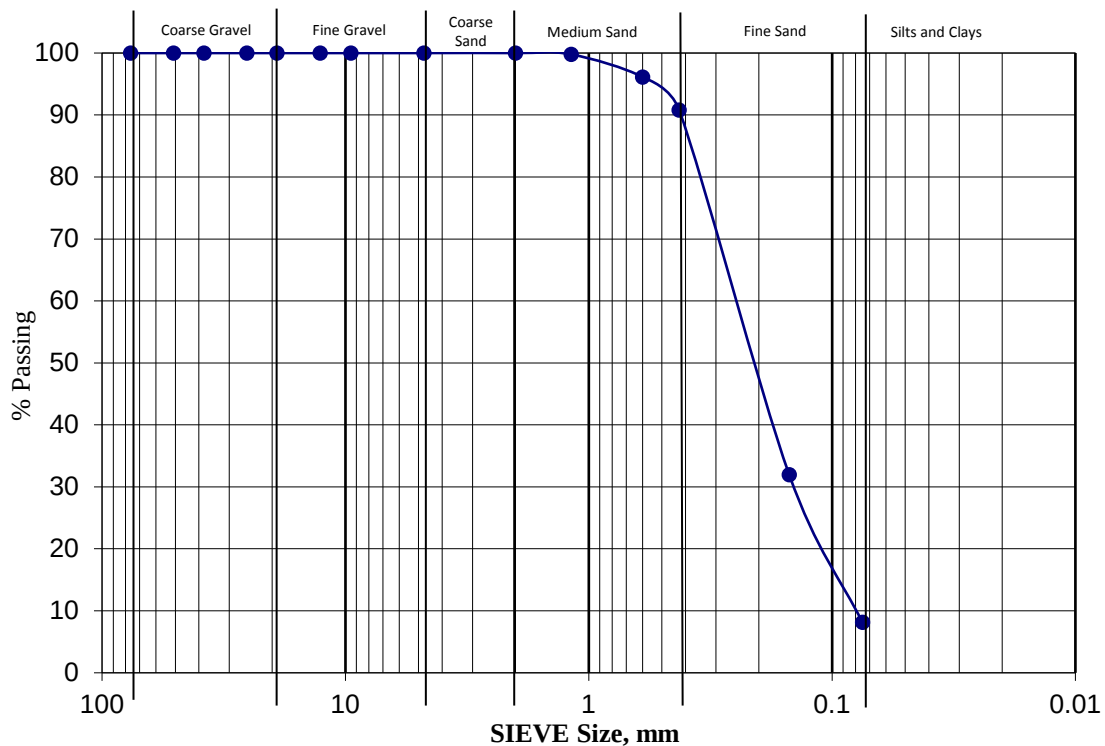
ASTM D6913

Job Name: Catavina Residential Development

Sample ID: B4 @ 10 feet

Description: Sand w/Silt (SP-SM)

Sieve Size	% Passing
3"	100
2"	100
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
#4	100
#10	100
#16	100
#30	96
#40	91
#100	32
#200	8.1



% Coarse Gravel:	0	% Coarse Sand:	0	Cu: 3.08 Cc: 1.02	Gradation
% Fine Gravel:	0	% Medium Sand:	9		
		% Fine Sand:	83	% Fines:	8
% Total Gravel	0	% Total Sand	92		Poorly Graded

SIEVE ANALYSIS

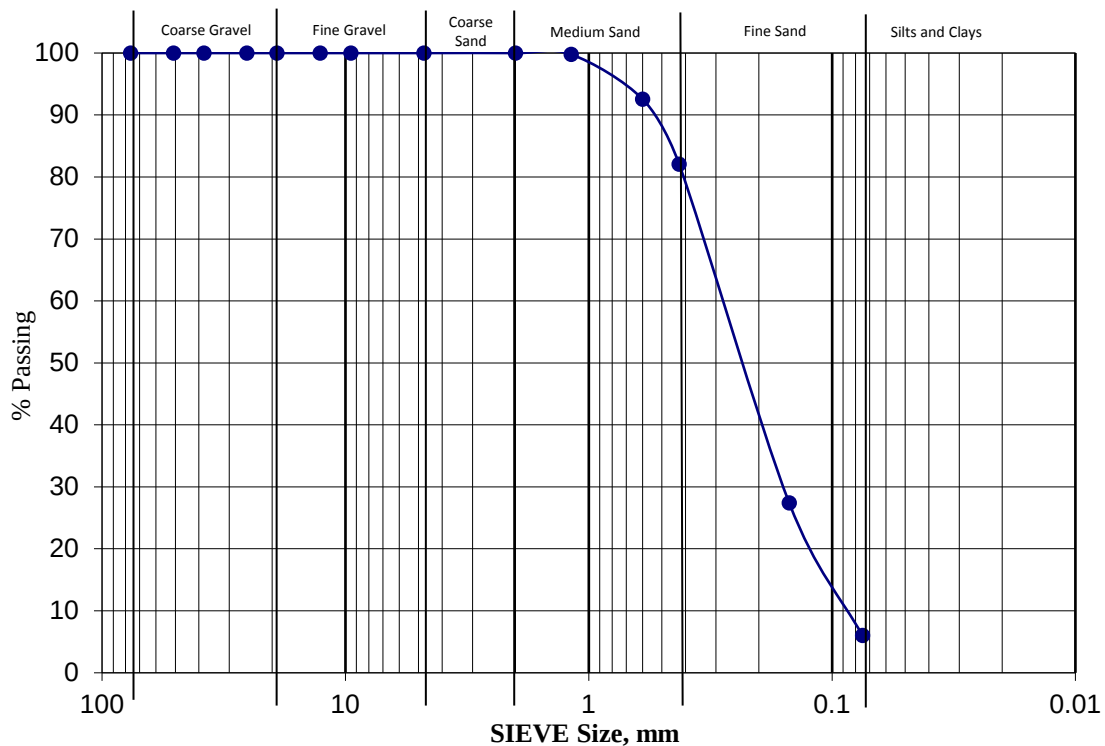
ASTM D6913

Job Name: Catavina Residential Development

Sample ID: B5 @ 0-5 feet

Description: Sand w/Silt (SP-SM)

Sieve Size	% Passing
3"	100
2"	100
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
#4	100
#10	100
#16	100
#30	93
#40	82
#100	27
#200	6.0



% Coarse Gravel:	0	% Coarse Sand:	0	Cu: 3.17 Cc: 1.01	Gradation
% Fine Gravel:	0	% Medium Sand:	18		
		% Fine Sand:	76	% Fines:	6
% Total Gravel	0	% Total Sand	94		Poorly Graded

File No.: 12329-01

February 6, 2015

Job Name: Catavina Residential Development

Lab Number: 15-012

AMOUNT PASSING NO. 200 SIEVE

ASTM D 1140

Sample Location	Depth (feet)	Fines Content (%)	USCS Group Symbol
B1	12.5	6	SP-SM
B1	30	9	SP-SM
B2	15	7	SP-SM
B3	7.5	6	SP-SM
B5	5	6	SP-SM
B6	15	7	SP-SM
B7	5	7	SP-SM
B8	20	8	SP-SM

CONSOLIDATION TEST**ASTM D 2435 & D 5333**

Catavina Residential Development

B-1 @ 10 feet

Sand w/Silt (SP-SM)

Ring Sample

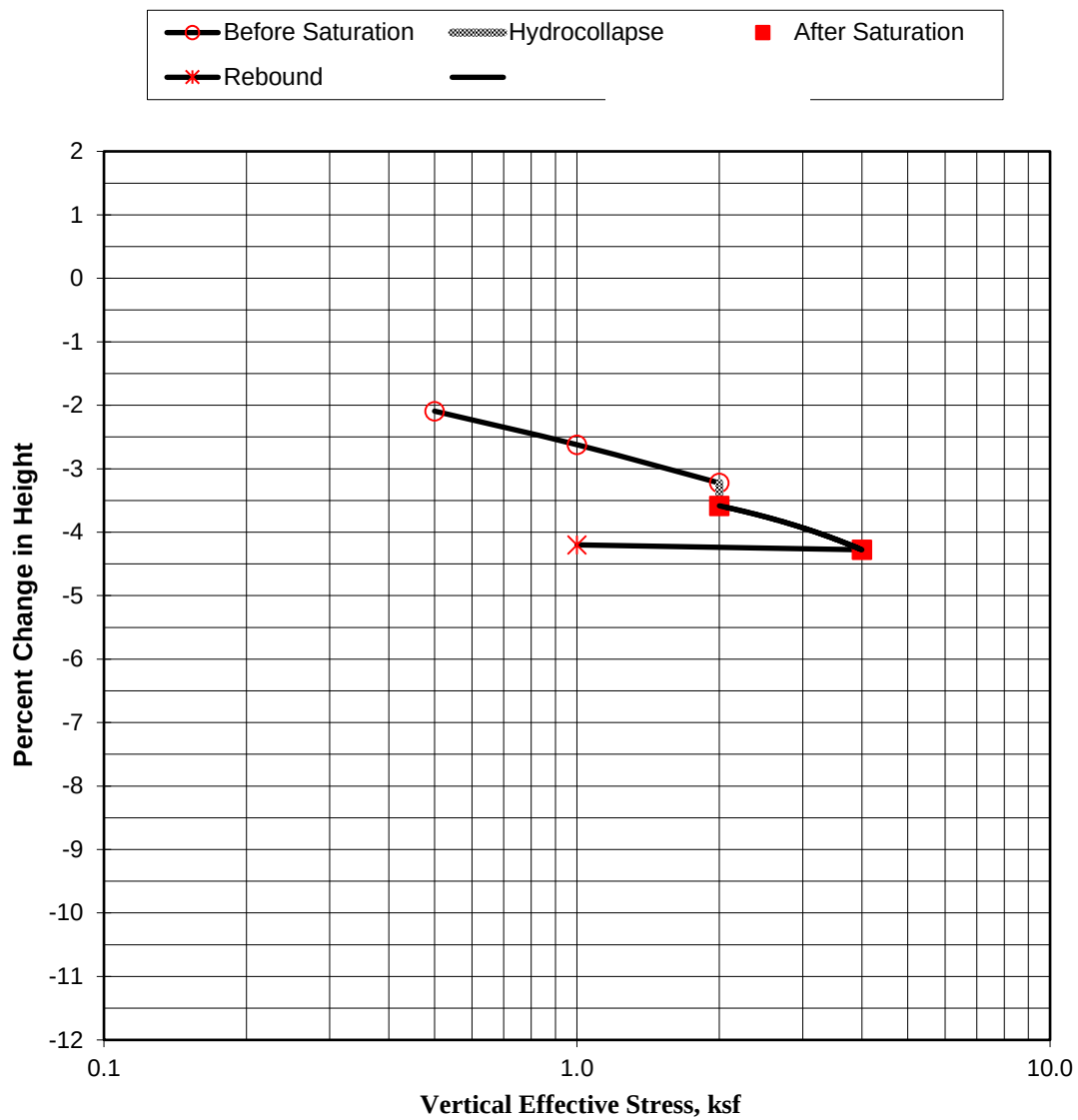
Initial Dry Density: 100.7 pcf

Initial Moisture, %: 3.5%

Specific Gravity (assumed): 2.67

Initial Void Ratio: 0.655

Hydrocollapse: 0.4% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram

CONSOLIDATION TEST**ASTM D 2435 & D 5333**

Catavina Residential Development

B-1 @ 25 feet

Sand w/Silt (SP-SM)

Ring Sample

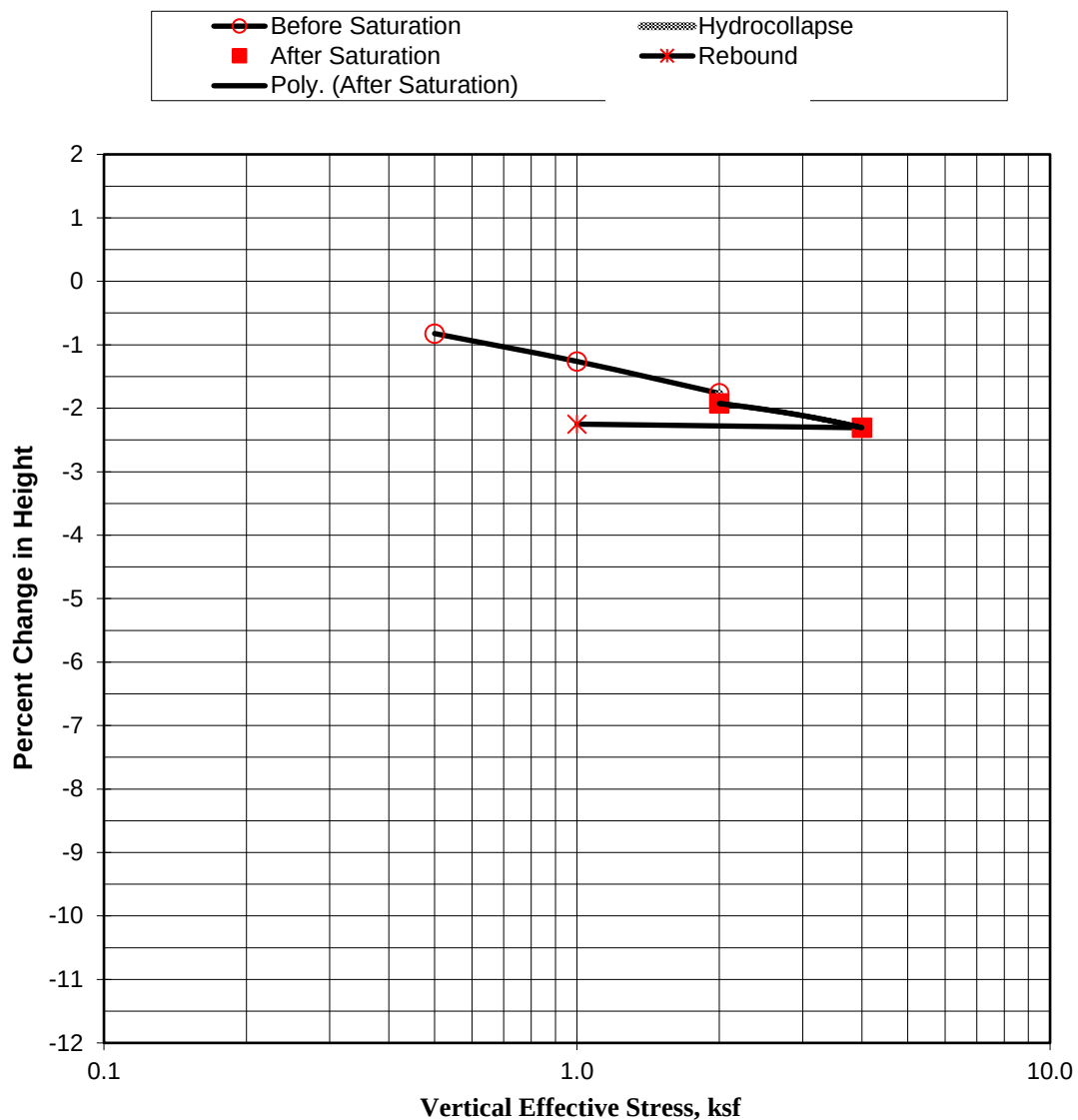
Initial Dry Density: 105.8 pcf

Initial Moisture, %: 3.8%

Specific Gravity (assumed): 2.67

Initial Void Ratio: 0.576

Hydrocollapse: 0.2% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram

CONSOLIDATION TEST**ASTM D 2435 & D 5333**

Catavina Residential Development

B-2 @ 7.5 feet

Sand w/Silt (SP-SM)

Ring Sample

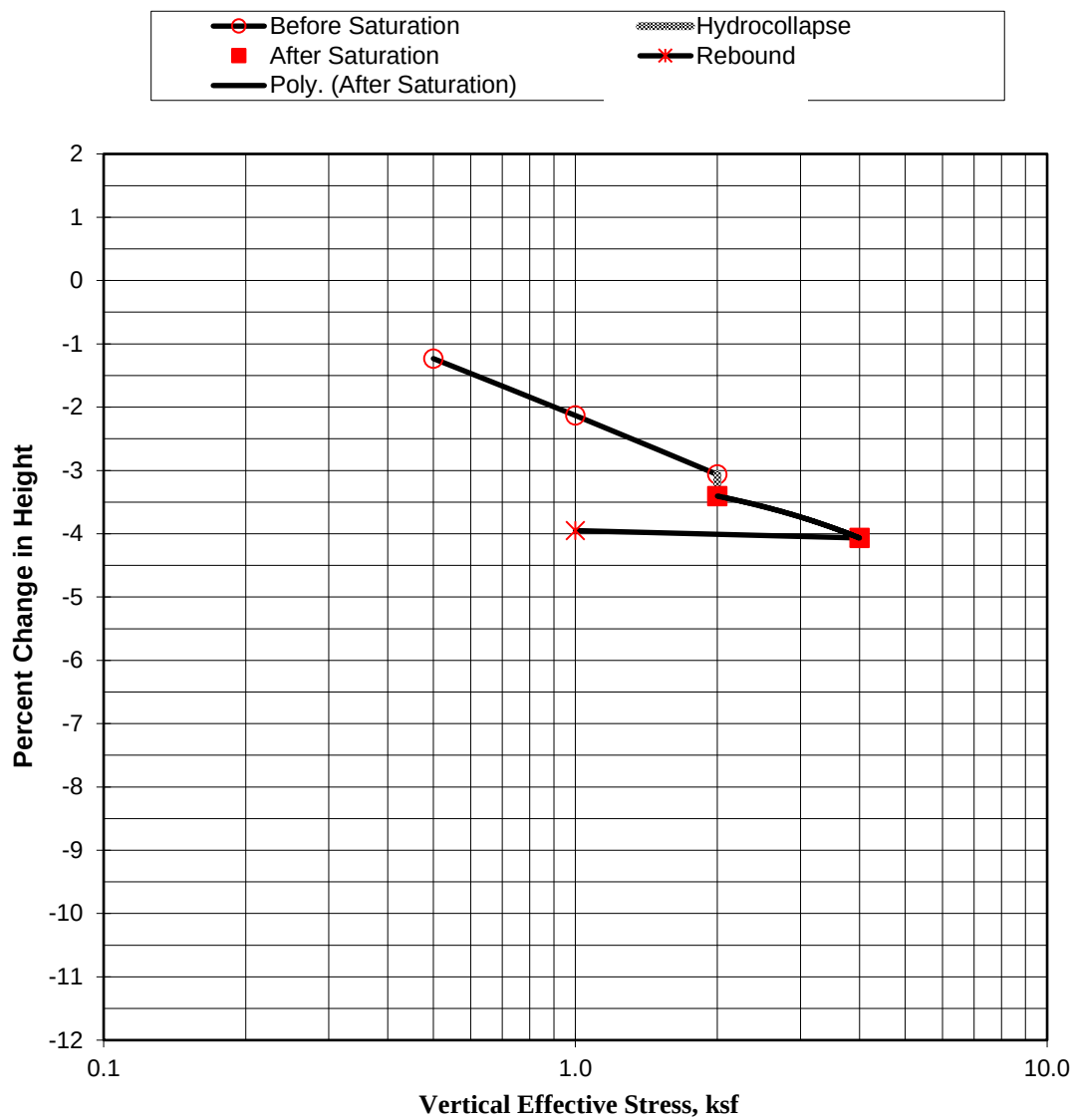
Initial Dry Density: 103.1 pcf

Initial Moisture, %: 4.2%

Specific Gravity (assumed): 2.67

Initial Void Ratio: 0.617

Hydrocollapse: 0.3% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram

CONSOLIDATION TEST**ASTM D 2435 & D 5333**

Catavina Residential Development

B-3 @ 5 feet

Sand w/Silt (SP-SM)

Ring Sample

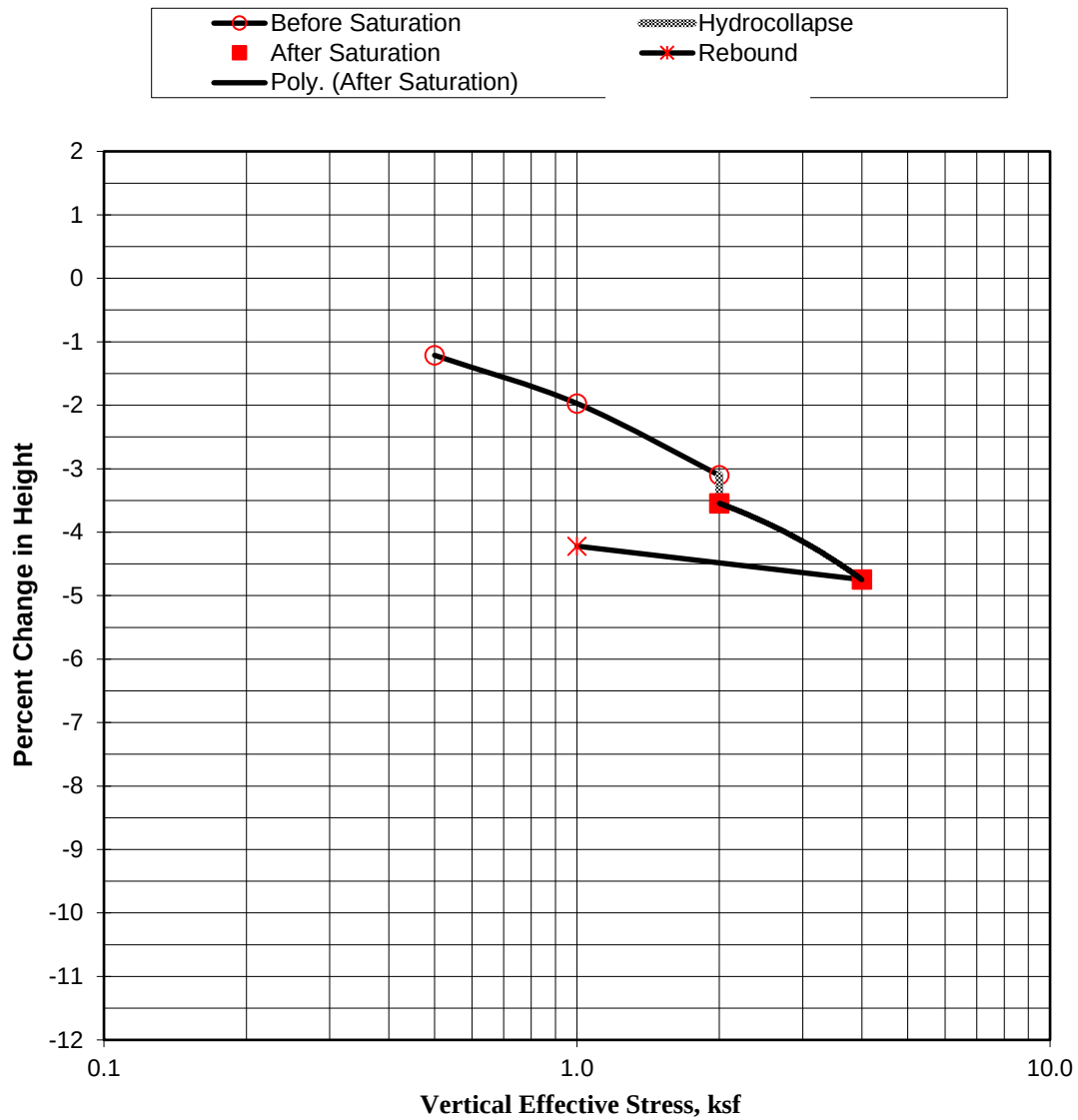
Initial Dry Density: 97.9 pcf

Initial Moisture, %: 5.2%

Specific Gravity (assumed): 2.67

Initial Void Ratio: 0.702

Hydrocollapse: 0.4% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram

CONSOLIDATION TEST**ASTM D 2435 & D 5333**

Catavina Residential Development

B-3 @ 20 feet

Sand w/Silt (SP-SM)

Ring Sample

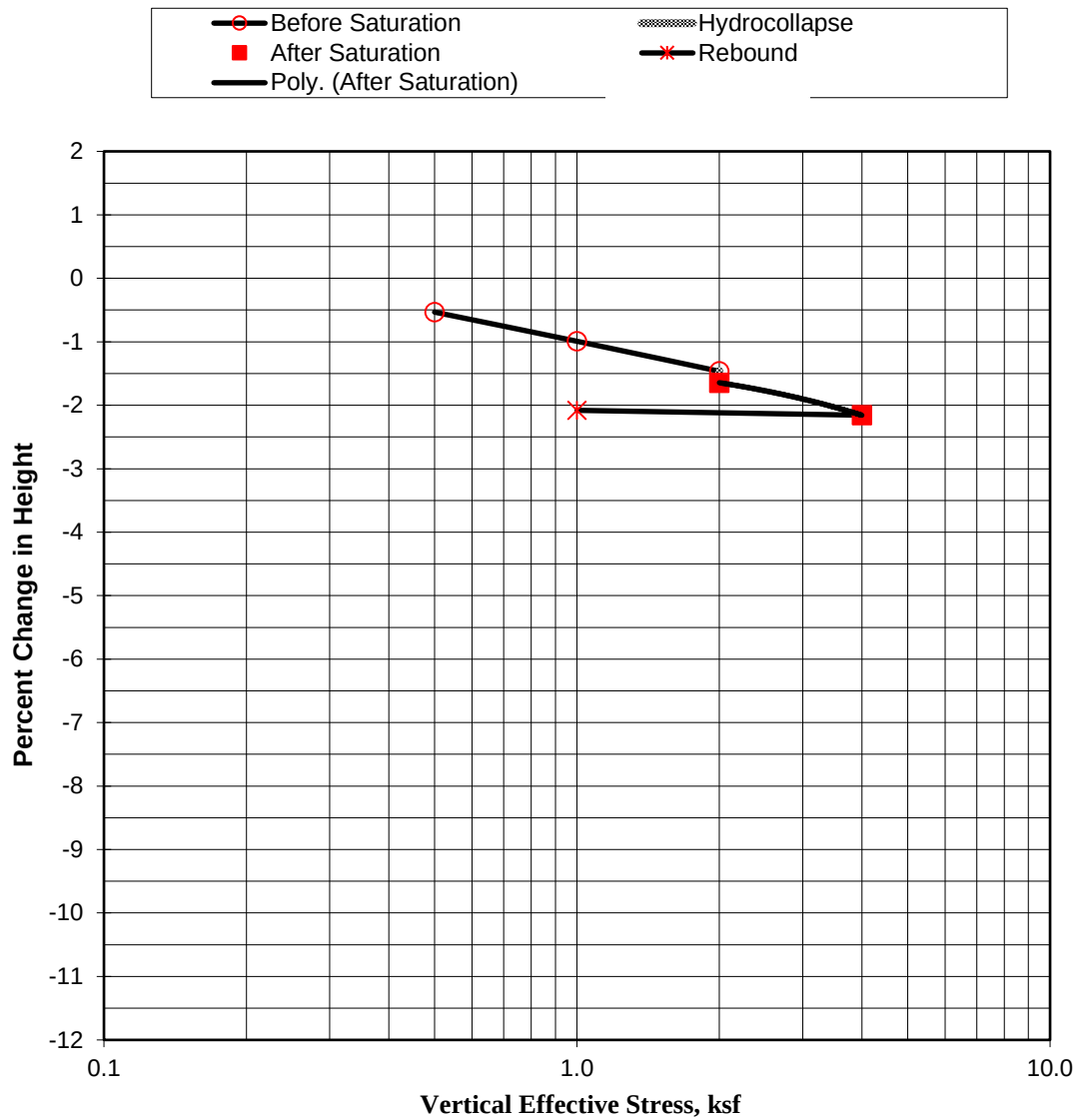
Initial Dry Density: 104.7 pcf

Initial Moisture, %: 4.6%

Specific Gravity (assumed): 2.67

Initial Void Ratio: 0.593

Hydrocollapse: 0.2% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram

CONSOLIDATION TEST**ASTM D 2435 & D 5333**

Catavina Residential Development

B4 @ 7 1/2 feet

Sand w/Silt (SP-SM)

Ring Sample

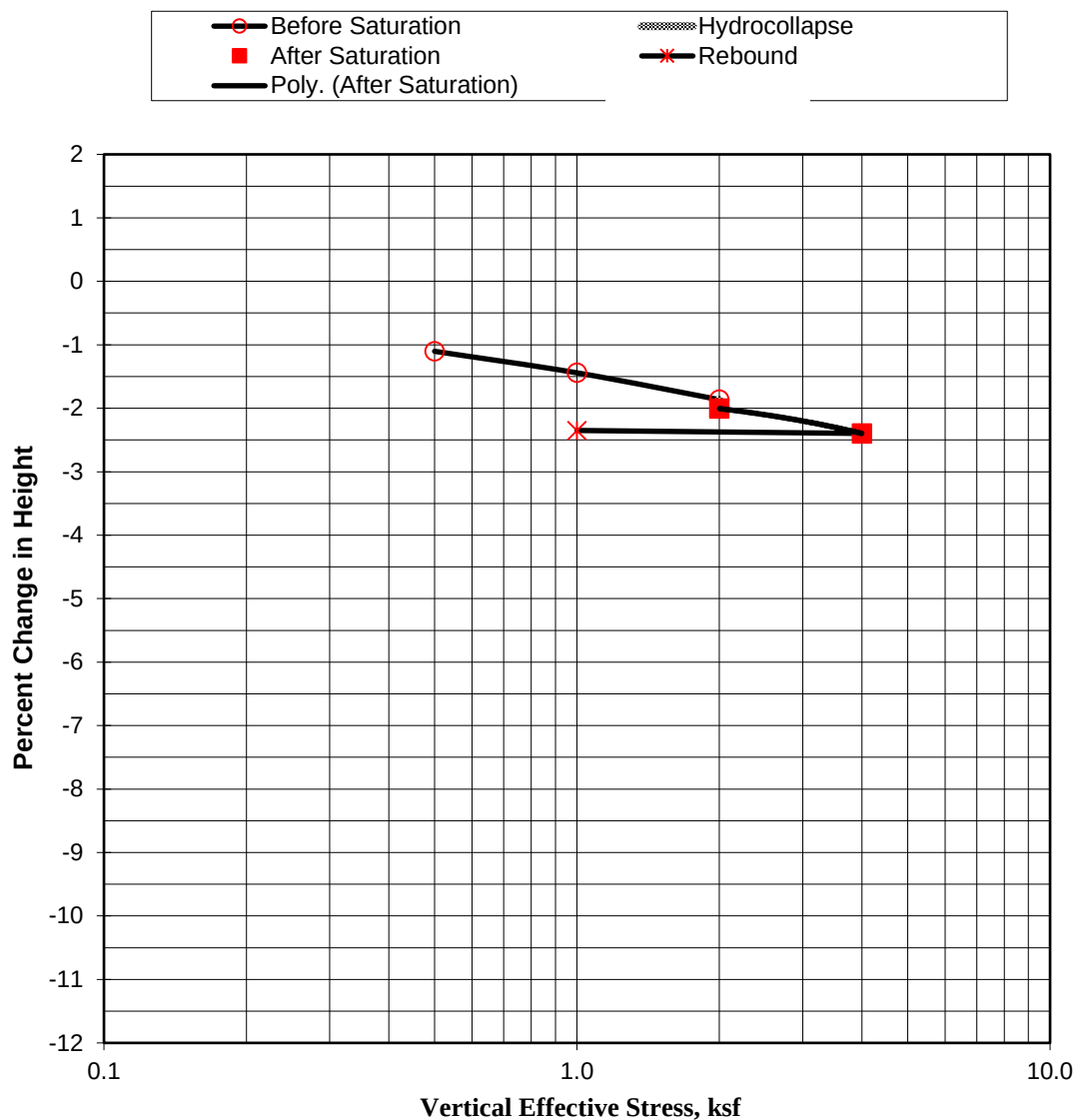
Initial Dry Density: 105.2 pcf

Initial Moisture, %: 3.0%

Specific Gravity (assumed): 2.67

Initial Void Ratio: 0.585

Hydrocollapse: 0.1% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram

CONSOLIDATION TEST**ASTM D 2435 & D 5333**

Catavina Residential Development

B5 @ 7 1/2 feet

Sand w/Silt (SP-SM)

Ring Sample

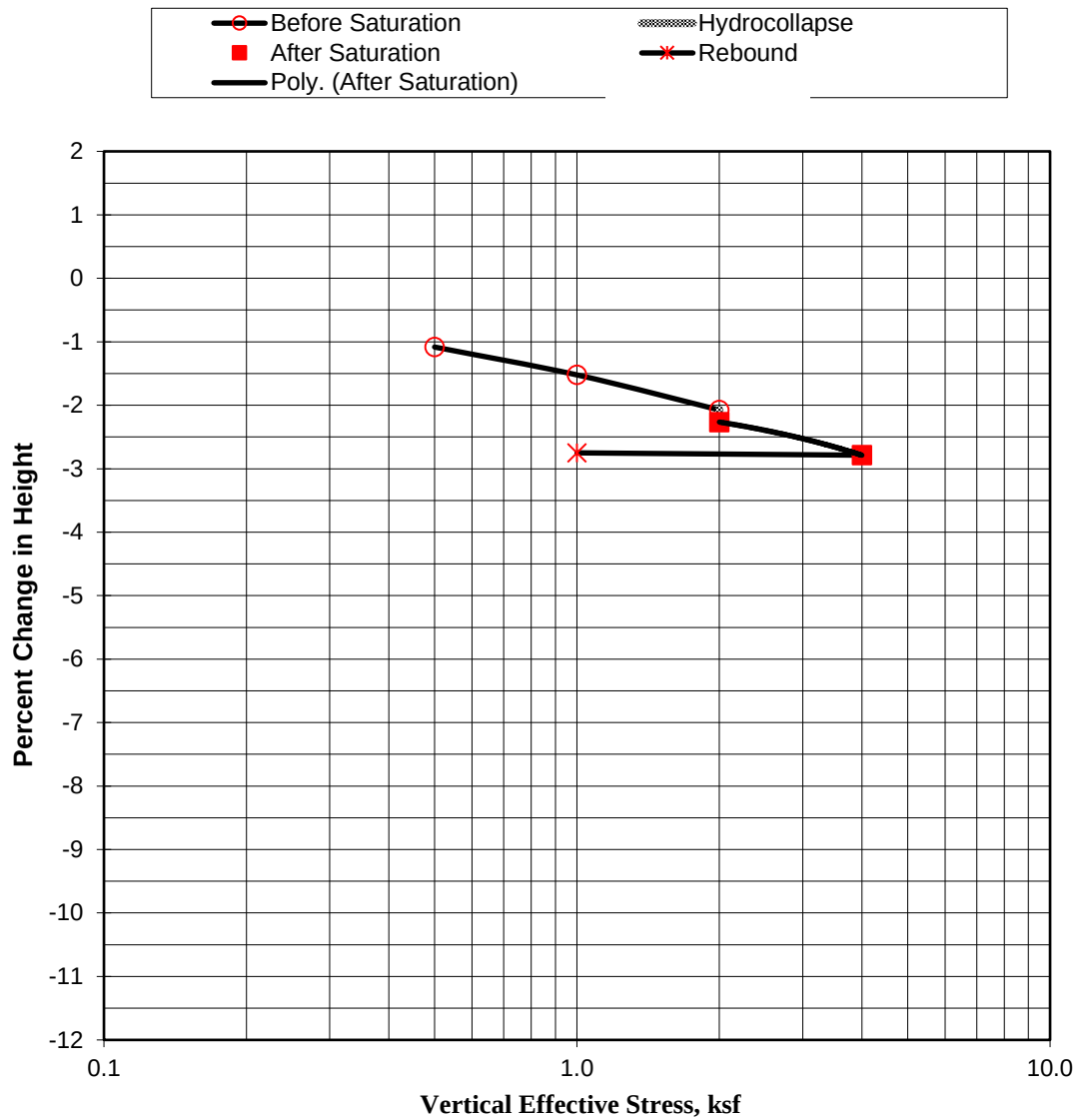
Initial Dry Density: 96.1 pcf

Initial Moisture, %: 4.3%

Specific Gravity (assumed): 2.67

Initial Void Ratio: 0.735

Hydrocollapse: 0.2% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram

CONSOLIDATION TEST**ASTM D 2435 & D 5333**

Catavina Residential Development

B6 @ 10 feet

Sand w/Silt (SP-SM)

Ring Sample

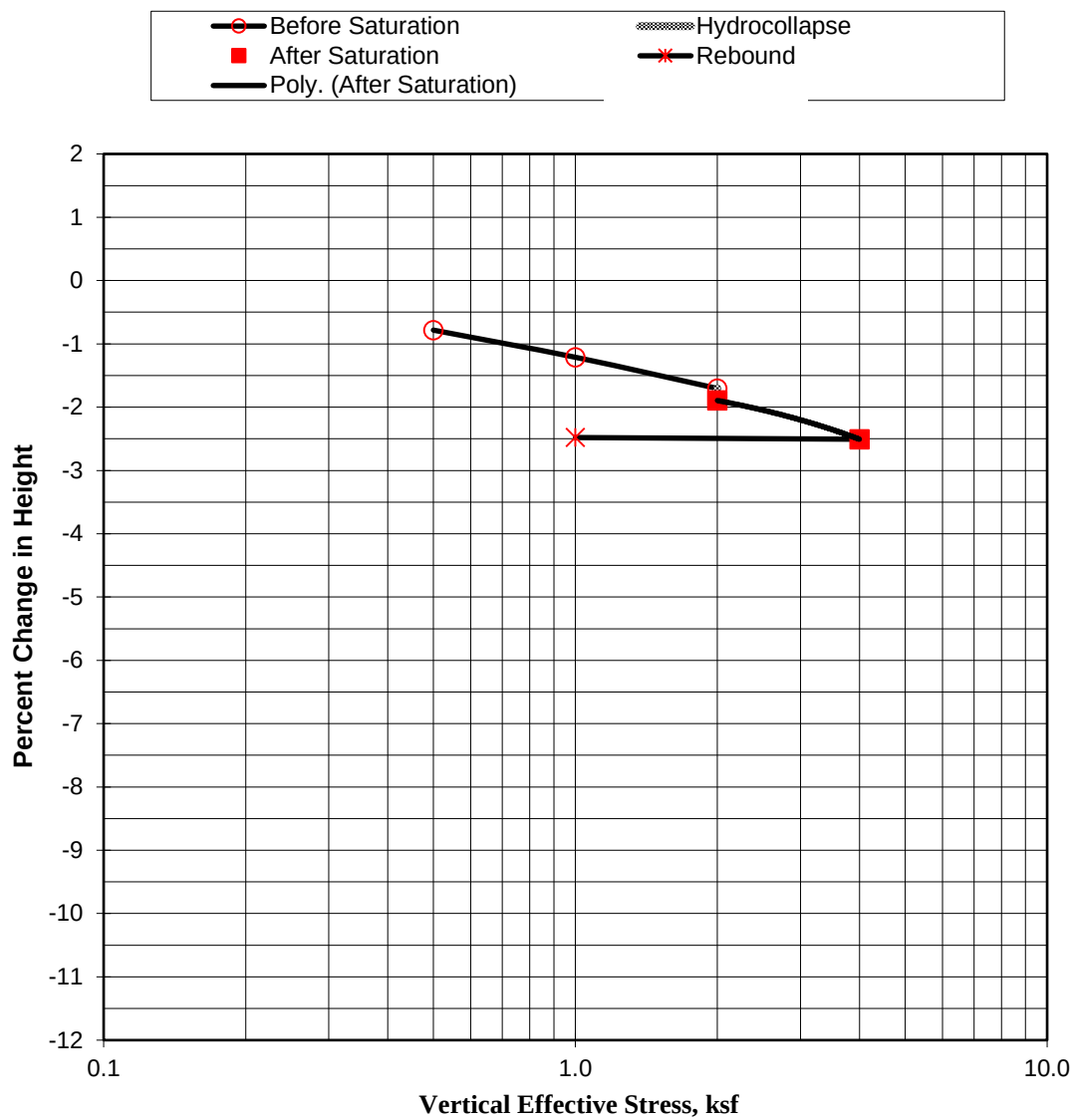
Initial Dry Density: 96.9 pcf

Initial Moisture, %: 4.2%

Specific Gravity (assumed): 2.67

Initial Void Ratio: 0.720

Hydrocollapse: 0.2% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram

CONSOLIDATION TEST**ASTM D 2435 & D 5333**

Catavina Residential Development

B7 @ 12 1/2 feet

Sand w/Silt (SP-SM)

Ring Sample

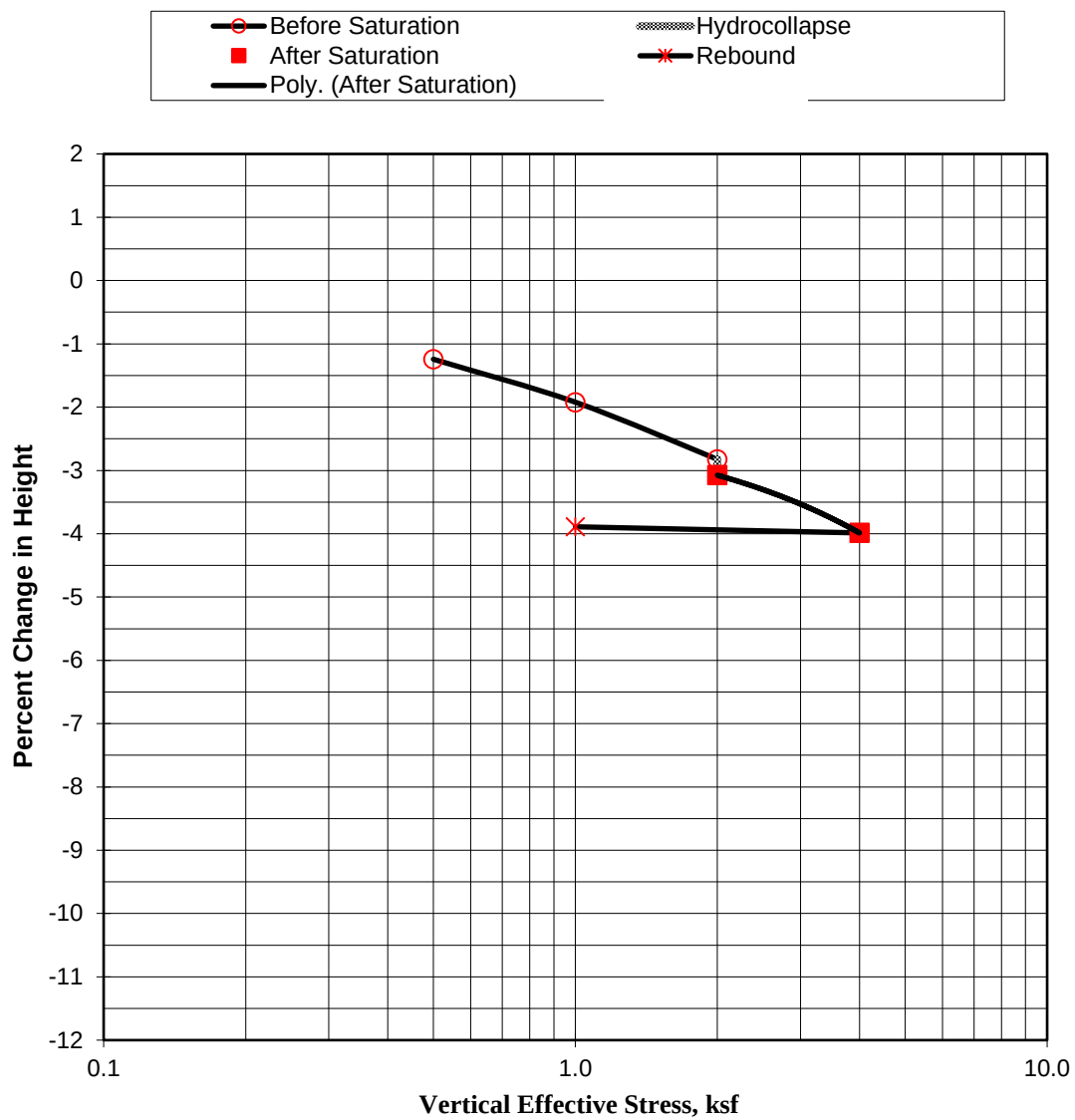
Initial Dry Density: 88.9 pcf

Initial Moisture, %: 7.3%

Specific Gravity (assumed): 2.67

Initial Void Ratio: 0.875

Hydrocollapse: 0.3% @ 2.0 ksf

% Change in Height vs Normal Pressure Diagram

MAXIMUM DRY DENSITY / OPTIMUM MOISTURE

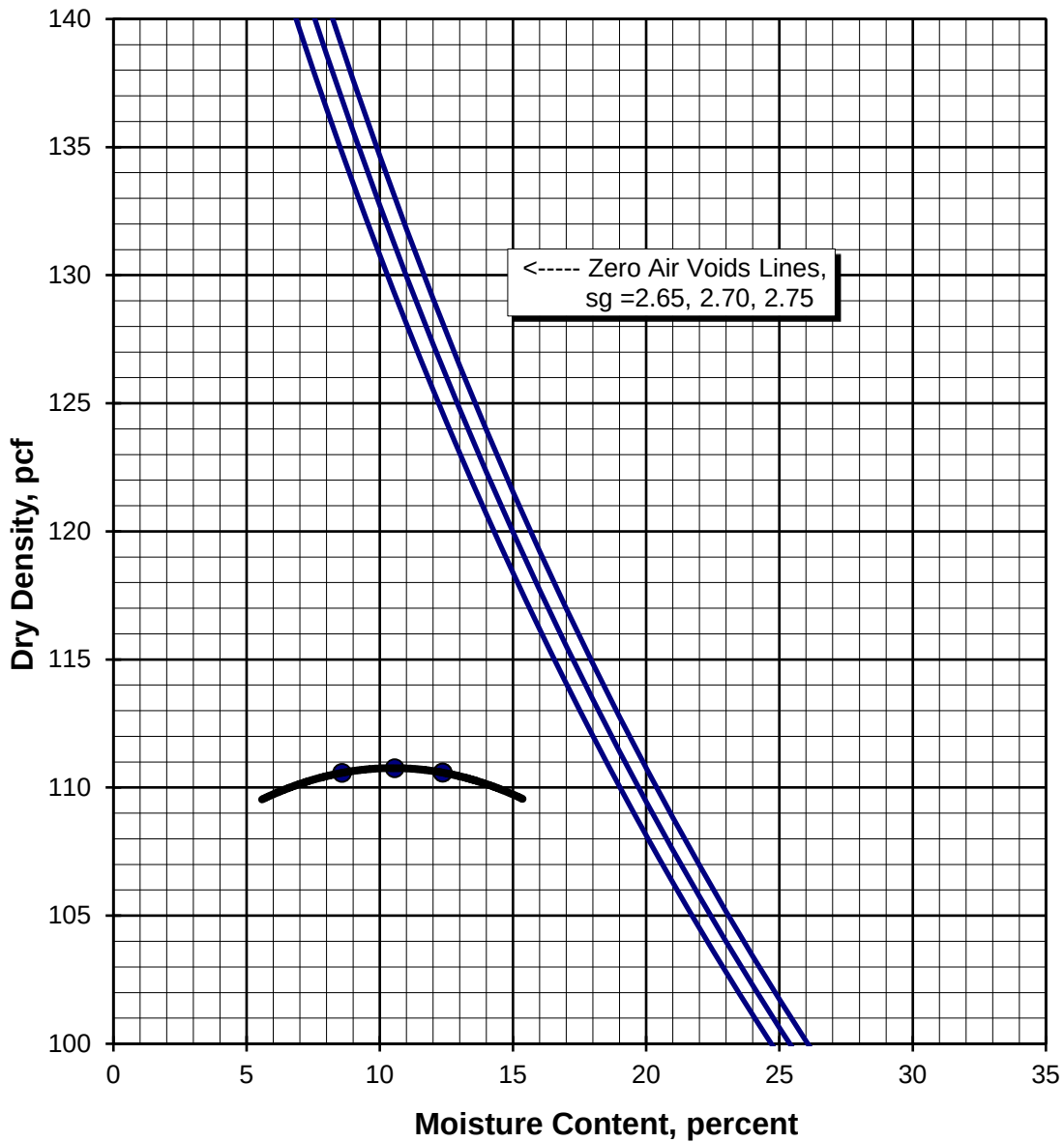
ASTM D 1557 (Modified)

Job Name: Catavina Residential Development
 Sample ID: 1
 Location: B1 @ 0-5 feet
 Description: Pale Yellowish Brown Fine to
 Medium Sand w/Silt (SP-SM)

Procedure Used: A
 Preparation Method: Moist
 Rammer Type: Mechanical
 Lab Number: 15-012

Maximum Dry Density: 110.8 pcf
Optimum Moisture: 10.6%

Sieve Size	% Retained (Cumulative)
3/4"	0.0
3/8"	0.0
#4	0.0



SOIL CHEMICAL ANALYSES

Job Name: Catavina Residential Development

Job No.: 12329-01

Sample ID:	B1	B3	B5		
Sample Depth, feet:	0-5	0-5	0-5	DF	RL
Sulfate, mg/Kg (ppm): (ASTM D 4327)	20	11	11	20	10.00
Chloride, mg/Kg (ppm): (ASTM D 4327)	37	22	23	20	4.00
pH, (pH Units): (ASTM D 1293)	8.49	8.42	8.39	1	---
Resistivity, (ohm-cm):	3,704	6,289	5,263	---	---
Conductivity, (mmhos-cm): (ASTM D 1125)	270	159	190	1	2.00

Note: Tests performed by Subcontract Laboratory:

Truesdail Laboratories, Inc.

14201 Franklin Avenue

Tustin, California 92780-7008 Tel: (714) 730-6462

DF: Dilution Factor

RL: Reporting Limit

N.D.: Not Detectable

General Guidelines for Soil Corrosivity		
Chemical Agent	Amount in Soil	Degree of Corrosivity
Soluble Sulfates ¹	0 -1,000 mg/Kg (ppm) [0-.1%]	Low
	1,000 - 2,000 mg/Kg (ppm) [0.1-0.2%]	Moderate
	2,000 - 20,000 mg/Kg (ppm) [0.2-2.0%]	Severe
	> 20,000 mg/Kg (ppm) [>2.0%]	Very Severe
Resistivity ²	0- 900 ohm-cm	Very Severely Corrosive
	900 to 2,300 ohm-cm	Severely Corrosive
	2,300 to 5,000 ohm-cm	Moderately Corrosive
	5,000-10,000 ohm-cm	Mildly Corrosive
	10,000+ ohm-cm	Progressively Less Corrosive

1 - General corrosivity to concrete elements. American Concrete Institute (ACI) Water Soluble Sulfate in Soil by Weight, ACI 318, Tables 4.2.2 - Exposure Conditions and Table 4.3.1 - Requirements for Concrete Exposed to Sulfate-Containing Solutions. It is recommended that concrete be proportioned in accordance with the requirements of the two ACI tables listed above (4.2.2 and 4.3.1). The current ACI should be referred to for further information.

2 - General corrosivity to metallic elements (iron, steel, etc.). Although no standard has been developed and accepted by corrosion engineering organizations, it is generally agreed that the classification shown above, or other similar classifications, reflect soil corrosivity. Source: Corrosionsource.com. The classification presented is excerpted from ASTM STP 1013 titled "Effects of Soil Characteristics on Corrosion" (February, 1989)

SOIL CHEMICAL ANALYSES

Job Name: Catavina Residential Development

Job No.: 12329-01

Sample ID:	B7		
Sample Depth, feet:	0-5	DF	RL
Sulfate, mg/Kg (ppm): (ASTM D 4327)	N.D.	20	10.00
Chloride, mg/Kg (ppm): (ASTM D 4327)	14	20	4.00
pH, (pH Units): (ASTM D 1293)	7.87	1	---
Resistivity, (ohm-cm):	6,579	---	---
Conductivity, (mmhos-cm): (ASTM D 1125)	152	1	2.00

Note: Tests performed by Subcontract Laboratory:

Truesdail Laboratories, Inc.

14201 Franklin Avenue

Tustin, California 92780-7008 Tel: (714) 730-6462

DF: Dilution Factor

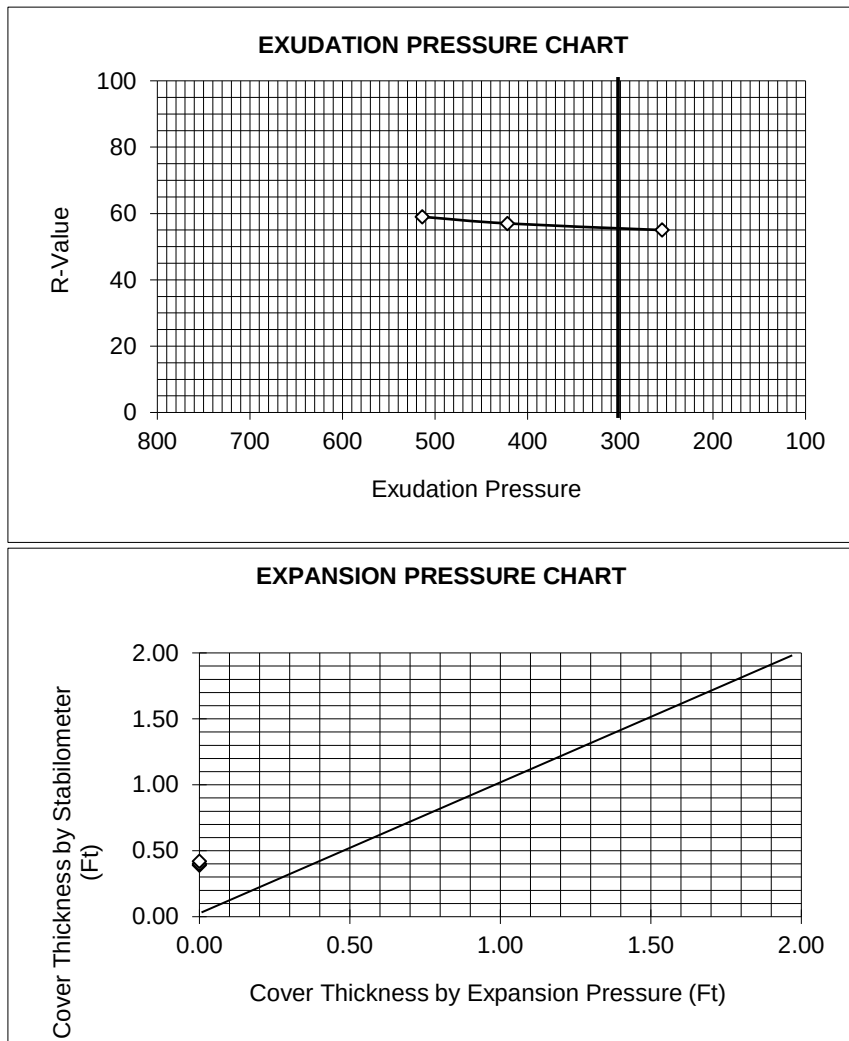
RL: Reporting Limit

N.D.: Not Detectable

General Guidelines for Soil Corrosivity		
Chemical Agent	Amount in Soil	Degree of Corrosivity
Soluble Sulfates ¹	0 -1,000 mg/Kg (ppm) [0-.1%]	Low
	1,000 - 2,000 mg/Kg (ppm) [0.1-0.2%]	Moderate
	2,000 - 20,000 mg/Kg (ppm) [0.2-2.0%]	Severe
	> 20,000 mg/Kg (ppm) [>2.0%]	Very Severe
Resistivity ²	0- 900 ohm-cm	Very Severely Corrosive
	900 to 2,300 ohm-cm	Severely Corrosive
	2,300 to 5,000 ohm-cm	Moderately Corrosive
	5,000-10,000 ohm-cm	Mildly Corrosive
	10,000+ ohm-cm	Progressively Less Corrosive

1 - General corrosivity to concrete elements. American Concrete Institute (ACI) Water Soluble Sulfate in Soil by Weight, ACI 318, Tables 4.2.2 - Exposure Conditions and Table 4.3.1 - Requirements for Concrete Exposed to Sulfate-Containing Solutions. *It is recommended that concrete be proportioned in accordance with the requirements of the two ACI tables listed above (4.2.2 and 4.3.1). The current ACI should be referred to for further information.*

2 - General corrosivity to metallic elements (iron, steel, etc.). Although no standard has been developed and accepted by corrosion engineering organizations, it is generally agreed that the classification shown above, or other similar classifications, reflect soil corrosivity. Source: Corrosionsource.com. The classification presented is excerpted from ASTM STP 1013 titled "Effects of Soil Characteristics on Corrosion" (February, 1989)



JOB NAME: Catavina Residential Development

SAMPLE I. D.: Boring B3 @ 0-5'

SOIL DESCRIPTION: Sand with Silt (SP-SM)

SPECIMEN NUMBER	A	B	C
EXUDATION PRESSURE	514	422	255
RESISTANCE VALUE	59	57	55
EXPANSION DIAL(0.0001")	0	0	0
EXPANSION PRESSURE (PSF)	0.0	0.0	0.0
% MOISTURE AT TEST	9.1	9.8	11.2
DRY DENSITY AT TEST	112.0	112.8	111.7

R-VALUE @ 300 PSI EXUDATION	55
R-VALUE by Expansion Pressure*	100

**Based on a Traffic Index of 5.0 and a Gravel Factor of 1.70*

APPENDIX B

GENERAL EARTHWORK GRADING GUIDELINES

Proposed Single- and Multi-Family Residential Developments

Catavina Project

38105 Portola Avenue

Palm Desert, Riverside County, California

Project No. 4038-CR



GENERAL GRADING GUIDELINES

Guidelines presented herein are intended to address general construction procedures for earthwork construction. Specific situations and conditions often arise which cannot reasonably be discussed in general guidelines, when anticipated these are discussed in the text of the report. Often unanticipated conditions are encountered which may necessitate modification or changes to these guidelines. It is our hope that these will assist the contractor to more efficiently complete the project by providing a reasonable understanding of the procedures that would be expected during earthwork and the testing and observation used to evaluate those procedures.

General

Grading should be performed to at least the minimum requirements of governing agencies, Chapters 18 and 33 of the Uniform Building Code, CBC (2022) and the guidelines presented below.

Preconstruction Meeting

A preconstruction meeting should be held prior to site earthwork. Any questions the contractor has regarding our recommendations, general site conditions, apparent discrepancies between reported and actual conditions and/or differences in procedures the contractor intends to use should be brought up at that meeting. The contractor (including the main onsite representative) should review our report and these guidelines in advance of the meeting. Any comments the contractor may have regarding these guidelines should be brought up at that meeting.

Grading Observation and Testing

1. Observation of the fill placement should be provided by our representative during grading. Verbal communication during the course of each day will be used to inform the contractor of test results. The contractor should receive a copy of the "Daily Field Report" indicating results of field density tests that day. If our representative does not provide the contractor with these reports, our office should be notified.
2. Testing and observation procedures are, by their nature, specific to the work or area observed and location of the tests taken, variability may occur in other locations. The contractor is responsible for the uniformity of the grading operations; our observations and test results are intended to evaluate the contractor's overall level of efforts during grading. The contractor's personnel are the only individuals participating in all aspect of site work. Compaction testing and observation should not be considered as relieving the contractor's responsibility to properly compact the fill.
3. Cleanouts, processed ground to receive fill, key excavations, and subdrains should be observed by our representative prior to placing any fill. It will be the contractor's responsibility to notify our representative or office when such areas are ready for observation.



4. Density tests may be made on the surface material to receive fill, as considered warranted by this firm.
5. In general, density tests would be made at maximum intervals of two feet of fill height or every 1,000 cubic yards of fill placed. Criteria will vary depending on soil conditions and size of the fill. More frequent testing may be performed. In any case, an adequate number of field density tests should be made to evaluate the required compaction and moisture content is generally being obtained.
6. Laboratory testing to support field test procedures will be performed, as considered warranted, based on conditions encountered (e.g. change of material sources, types, etc.) Every effort will be made to process samples in the laboratory as quickly as possible and in progress construction projects are our first priority. However, laboratory workloads may cause in delays and some soils may require a **minimum of 48 to 72 hours to complete test procedures**. Whenever possible, our representative(s) should be informed in advance of operational changes that might result in different source areas for materials.
7. Procedures for testing of fill slopes are as follows:
 - a) Density tests should be taken periodically during grading on the flat surface of the fill, three to five feet horizontally from the face of the slope.
 - b) If a method other than over building and cutting back to the compacted core is to be employed, slope compaction testing during construction should include testing the outer six inches to three feet in the slope face to determine if the required compaction is being achieved.
8. Finish grade testing of slopes and pad surfaces should be performed after construction is complete.

Site Clearing

1. All vegetation, and other deleterious materials, should be removed from the site. If material is not immediately removed from the site it should be stockpiled in a designated area(s) well outside of all current work areas and delineated with flagging or other means. Site clearing should be performed in advance of any grading in a specific area.
2. Efforts should be made by the contractor to remove all organic or other deleterious material from the fill, as even the most diligent efforts may result in the incorporation of some materials. This is especially important when grading is occurring near the natural grade. All equipment operators should be aware of these efforts. Laborers may be required as root pickers.
3. Nonorganic debris or concrete may be placed in deeper fill areas provided the procedures used are observed and found acceptable by our representative.

Treatment of Existing Ground

1. Following site clearing, all surficial deposits of alluvium and colluvium as well as weathered or creep affected bedrock, should be removed unless otherwise specifically indicated in the text of this report.
2. In some cases, removal may be recommended to a specified depth (e.g. flat sites where partial alluvial removals may be sufficient). The contractor should not exceed these depths unless directed otherwise by our representative.
3. Groundwater existing in alluvial areas may make excavation difficult. Deeper removals than indicated in the text of the report may be necessary due to saturation during winter months.
4. Subsequent to removals, the natural ground should be processed to a depth of six inches, moistened to near optimum moisture conditions and compacted to fill standards.
5. Exploratory back hoe or dozer trenches still remaining after site removal should be excavated and filled with compacted fill if they can be located.

Fill Placement

1. Unless otherwise indicated, all site soil and bedrock may be reused for compacted fill; however, some special processing or handling may be required (see text of report).
2. Material used in the compacting process should be evenly spread, moisture conditioned, processed, and compacted in thin lifts six (6) to eight (8) inches in compacted thickness to obtain a uniformly dense layer. The fill should be placed and compacted on a nearly horizontal plane, unless otherwise found acceptable by our representative.
3. If the moisture content or relative density varies from that recommended by this firm, the contractor should rework the fill until it is in accordance with the following:
 - a) Moisture content of the fill should be at or above optimum moisture. Moisture should be evenly distributed without wet and dry pockets. Pre-watering of cut or removal areas should be considered in addition to watering during fill placement, particularly in clay or dry surficial soils. The ability of the contractor to obtain the proper moisture content will control production rates.
 - b) Each six-inch layer should be compacted to at least 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency. In most cases, the testing method is ASTM Test Designation D 1557.
4. Rock fragments less than eight inches in diameter may be utilized in the fill, provided:
 - a) They are not placed in concentrated pockets;
 - b) There is a sufficient percentage of fine-grained material to surround the rocks;
 - c) The distribution of the rocks is observed by, and acceptable to, our representative.

5. Rocks exceeding eight (8) inches in diameter should be taken off site, broken into smaller fragments, or placed in accordance with recommendations of this firm in areas designated suitable for rock disposal. On projects where significant large quantities of oversized materials are anticipated, alternate guidelines for placement may be included. If significant oversize materials are encountered during construction, these guidelines should be requested.
6. In clay soil, dry or large chunks or blocks are common. If in excess of eight (8) inches minimum dimension, then they are considered as oversized. Sheepsfoot compactors or other suitable methods should be used to break up blocks. When dry, they should be moisture conditioned to provide a uniform condition with the surrounding fill.

Slope Construction

1. The contractor should obtain a minimum relative compaction of 90 percent out to the finished slope face of fill slopes. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment.
2. Slopes trimmed to the compacted core should be overbuilt by at least three (3) feet with compaction efforts out to the edge of the false slope. Failure to properly compact the outer edge results in trimming not exposing the compacted core and additional compaction after trimming may be necessary.
3. If fill slopes are built "at grade" using direct compaction methods, then the slope construction should be performed so that a constant gradient is maintained throughout construction. Soil should not be "spilled" over the slope face nor should slopes be "pushed out" to obtain grades. Compaction equipment should compact each lift along the immediate top of slope. Slopes should be back rolled or otherwise compacted at approximately every 4 feet vertically as the slope is built.
4. Corners and bends in slopes should have special attention during construction as these are the most difficult areas to obtain proper compaction.
5. Cut slopes should be cut to the finished surface. Excessive undercutting and smoothing of the face with fill may necessitate stabilization.

UTILITY TRENCH CONSTRUCTION AND BACKFILL

Utility trench excavation and backfill is the contractor's responsibility. The geotechnical consultant typically provides periodic observation and testing of these operations. While efforts are made to make sufficient observations and tests to verify that the contractors' methods and procedures are adequate to achieve proper compaction, it is typically impractical to observe all backfill procedures. As such, it is critical that the contractor use consistent backfill procedures.

Compaction methods vary for trench compaction and experience indicates many methods can be successful. However, procedures that “worked” on previous projects may or may not prove effective on a given site. The contractor(s) should outline the procedures proposed, so that we may discuss them **prior** to construction. We will offer comments based on our knowledge of site conditions and experience.

1. Utility trench backfill in slopes, structural areas, in streets and beneath flat work or hardscape should be brought to at least optimum moisture and compacted to at least 90 percent of the laboratory standard. Soil should be moisture conditioned prior to placing in the trench.
2. Flooding and jetting are not typically recommended or acceptable for native soils. Flooding or jetting may be used with select sand having a Sand Equivalent (SE) of 30 or higher. This is typically limited to the following uses:
 - a) shallow (12 + inches) under slab interior trenches and,
 - b) as bedding in pipe zone.

The water should be allowed to dissipate prior to pouring slabs or completing trench compaction.

3. Care should be taken not to place soils at high moisture content within the upper three feet of the trench backfill in street areas, as overly wet soils may impact subgrade preparation. Moisture may be reduced to 2% below optimum moisture in areas to be paved within the upper three feet below sub grade.
4. Sand backfill should not be allowed in exterior trenches adjacent to and within an area extending below a 1:1 projection from the outside bottom edge of a footing, unless it is similar to the surrounding soil.
5. Trench compaction testing is generally at the discretion of the geotechnical consultant. Testing frequency will be based on trench depth and the contractor’s procedures. A probing rod would be used to assess the consistency of compaction between tested areas and untested areas. If zones are found that are considered less compact than other areas, this would be brought to the contractor’s attention.

JOB SAFETY

General

Personnel safety is a primary concern on all job sites. The following summaries are safety considerations for use by all our employees on multi-employer construction sites. On ground personnel are at highest risk of injury and possible fatality on grading construction projects. The company recognizes that construction activities will vary on each site and that job site safety is the contractor's responsibility. However, it is, imperative that all personnel be safety conscious to avoid accidents and potential injury.



In an effort to minimize risks associated with geotechnical testing and observation, the following precautions are to be implemented for the safety of our field personnel on grading and construction projects.

1. Safety Meetings: Our field personnel are directed to attend the contractor's regularly scheduled safety meetings.
2. Safety Vests: Safety vests are provided for and are to be worn by our personnel while on the job site.
3. Safety Flags: Safety flags are provided to our field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

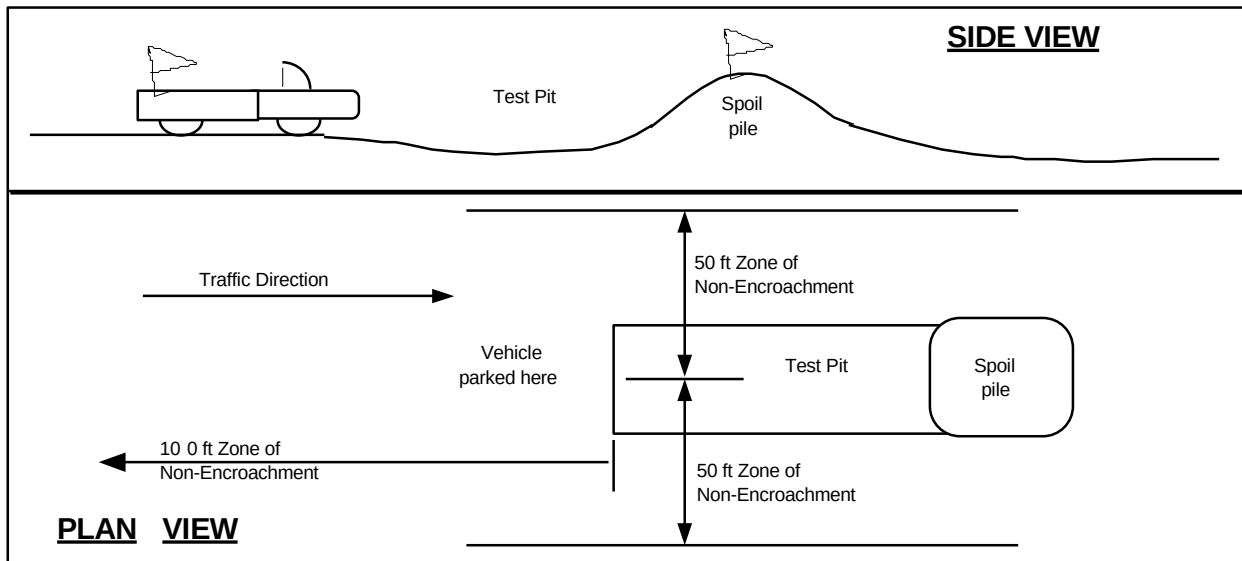
In the event that the contractor's representative observes any of our personnel not following the above, we request that it be brought to the attention of our office.

Test Pits Location, Orientation and Clearance

The technician is responsible for selecting test pit locations. The primary concern is the technician's safety. However, it is necessary to take sufficient tests at various locations to obtain a representative sampling of the fill. As such, efforts will be made to coordinate locations with the grading contractors authorized representatives (e.g. dump man, operator, supervisor, grade checker, etc.), and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractors authorized representative should direct excavation of the pit and safety during the test period. Again, safety is the paramount concern.

Test pits should be excavated so that the spoil pile is placed away from oncoming traffic. The technician's vehicle is to be placed next to the test pit, opposite the spoil pile. This necessitates that the fill be maintained in a drivable condition. Alternatively, the contractor may opt to park a piece of equipment in front of test pits, particularly in small fill areas or those with limited access.

A zone of non-encroachment should be established for all test pits (see diagram below). No grading equipment should enter this zone during the test procedure. The zone should extend outward to the sides approximately 50 feet from the center of the test pit and 100 feet in the direction of traffic flow. This zone is established both for safety and to avoid excessive ground vibration, which typically decreases test results.

TEST PIT SAFETY PLAN**Slope Tests**

When taking slope tests, the technician should park their vehicle directly above or below the test location on the slope. The contractor's representative should effectively keep all equipment at a safe operation distance (e.g., 50 feet) away from the slope during testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location.

Trench Safety

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Trenches for all utilities should be excavated in accordance with CAL-OSHA and any other applicable safety standards. Safe conditions will be required to enable compaction testing of the trench backfill.

All utility trench excavations in excess of 5 feet deep, which a person enters, are to be shored or laid back. Trench access should be provided in accordance with OSHA standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

Our personnel are directed not to enter any excavation which:

1. is 5 feet or deeper unless shored or laid back,
2. exit points or ladders are not provided,
3. displays any evidence of instability, has any loose rock or other debris which could fall into the trench, or

4. displays any other evidence of any unsafe conditions regardless of depth.

If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraws and notifies their supervisor. The contractor's representative will then be contacted in an effort to effect a solution. All backfill not tested due to safety concerns or other reasons is subject to reprocessing and/or removal.

Procedures

In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is directed to inform both the developer's and contractor's representatives. If the condition is not rectified, the technician is required, by company policy, to immediately withdraw and notify their supervisor. The contractor's representative will then be contacted in an effort to effect a solution. No further testing will be performed until the situation is rectified. Any fill placed in the interim can be considered unacceptable and subject to reprocessing, recompaction or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to technicians attention and notify our project manager or office. Effective communication and coordination between the contractor's representative and the field technician(s) is strongly encouraged in order to implement the above safety program and safety in general.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

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