GEOTECHNICAL INVESTIGATION PROPOSED COMMERCIAL/INDUSTRIAL DEVELOPMENT

8643 Eucalyptus Avenue
Ontario, California
for
Liberty Property Trust

SoCalGeo
SOUTHERN
CALIFORNIA
GEOTECHNICAL
A California Corporation

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

May 18, 2017

Liberty Property Trust
8827 North Sam Houston Parkway West
Houston, Texas 77064

Attention: Mr. Ken Chang, CCIM, PE, LEED AP
Director, Development

Project No.: **17G129-1**

Subject: **Geotechnical Investigation**
Proposed Commercial/Industrial Development
8643 Eucalyptus Avenue
Ontario, California

Gentlemen:

In accordance with your request, we have conducted a geotechnical investigation at the subject site. We are pleased to present this report summarizing the conclusions and recommendations developed from our investigation.

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

SOUTHERN CALIFORNIA GEOTECHNICAL, INC.

Daniel W. Nielsen, RCE 77915
Project Engineer

Robert G. Trazo, GE 2655
Principal Engineer

Distribution: (1) Addressee

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

Presented below is a brief summary of the conclusions and recommendations of this investigation. Since this summary is not all inclusive, it should be read in complete context with the entire report.

Site Preparation Recommendations

- Demolition of the existing structures, including the residence, milking barn, sheds, canopy shelters, and the existing pavements will be required in order to facilitate construction of the new buildings. Demolition of these structures should include all foundations, floor slabs, utilities, septic systems, and any other subsurface improvements that will not remain in place for use with the new development. Debris resultant from demolition should be disposed of offsite. Alternatively, concrete and asphalt debris may be pulverized to a maximum 2 inch particle size, well mixed with the on-site soils, and incorporated into new structural fills or it may be crushed and made into crushed miscellaneous base (CMB).
- Site stripping should include all vegetation, organic soils, and root masses. These materials should be disposed of offsite. Site stripping should also include removal of all manure and any significant topsoil. These materials should also be disposed of off-site. Surficial layers of manure were observed throughout the cattle pen areas and in the southeastern portion of the site, where cattle wash-water is disposed of, with thickness of 3 to 12± inches at the boring and trench locations. Several stockpiles of manure were also observed in the western portion of the site.
- The near surface soils encountered at the boring and trench locations generally consist of loose to medium dense fine sands, silty sands and occasional fine sandy silts. Based on their variable densities and minor potentials for consolidation and collapse, remedial grading is considered warranted to remove a portion of the near surface alluvium from the proposed building pad area. Additionally, artificial fill soils were encountered in isolated areas extending to depths of 1½ to 5½± feet. Any artificial fill soils and any soils disturbed during the demolition of the dairy farm structures should be removed from the building areas in their entirety.
- Remedial grading should be performed within the proposed building areas to remove a portion of the near surface alluvium, any artificial fill, and any disturbed soils. The near surface soils should be overexcavated to a depth of at least 3 feet below existing site grades and to a depth of at least 3feet below the proposed building pad subgrade elevations. Within the influence zones of new foundations, the overexcavation should extend to a depth of at least 2 feet below the proposed foundation bearing grade.
- After the overexcavation has been completed, the resulting subgrade soils should be evaluated by the geotechnical engineer to identify any additional soils that should be removed. Resulting subgrade should then be scarified to a depth of at least 12 inches and moisture conditioned to 2 to 4 percent above optimum. The previously excavated soils may then be replaced as compacted structural fill. All structural fill soils should be compacted to at least 90 percent of the ASTM D-1557 maximum dry density.
- The new pavement subgrade soils are recommended to be scarified to a depth of 12± inches, thoroughly moisture conditioned and recompacted to at least 90 percent of the ASTM D-1557 maximum dry density.

Foundation Design Recommendations

- Conventional shallow foundations, supported in newly placed compacted fill.
- Maximum, net allowable soil bearing pressure: 2,500 lbs/ft^2.
- Reinforcement consisting of four (4) No. 5 rebars in strip footings. Additional reinforcement may be necessary for structural considerations.

Floor Slab Design Recommendations

- Conventional Slabs-on-Grade, minimum 6 inches thick.
- Modulus of Subgrade Reaction: k = 125 psi/in.
- Slab reinforcement is not required based on geotechnical conditions. The actual thickness and reinforcement of the floor slabs should be determined by the structural engineer based on the imposed loading.

Pavement Design Recommendations

ASPHALT PAVEMENTS (R = 40)					
Materials	**Thickness (inches)**				
	Auto Parking and Auto Drive Lanes (TI = 4.0 to 5.0)	Truck Traffic			
		TI = 6.0	TI = 7.0	TI = 8.0	TI = 9.0
Asphalt Concrete	3	3½	4	5	5½
Aggregate Base	4	6	7	8	10
Compacted Subgrade	12	12	12	12	12

PORTLAND CEMENT CONCRETE PAVEMENTS				
Materials	**Thickness (inches)**			
	Autos and Light Truck Traffic (TI = 6.0)	Truck Traffic		
		TI = 7.0	TI = 8.0	TI = 9.0
PCC	5	6½	8	9
Compacted Subgrade (95% minimum compaction)	12	12	12	12

2.0 SCOPE OF SERVICES

The scope of services performed for this project was in accordance with our Proposal No. 17P181, dated March 17, 2017. The scope of services included a visual site reconnaissance, subsurface exploration, field and laboratory testing, and geotechnical engineering analysis to provide criteria for preparing the design of the building foundations, building floor slab, and parking lot pavements along with site preparation recommendations and construction considerations for the proposed development. The evaluation of the environmental aspects of this site was beyond the scope of services for this geotechnical investigation.

3.0 SITE AND PROJECT DESCRIPTION

3.1 Site Conditions

The subject site is located at the street address of 8643 Eucalyptus Avenue in Ontario, California. The site is bounded to the south by Merrill Avenue, to the north by Eucalyptus Avenue, and to the west and east by agricultural parcels. Based on conversations with the client and on documents provided by the client, the subject site is also identified as the G.H. Dairy site. The general location of the site is illustrated on the Site Location Map, enclosed as Plate 1 in Appendix A of this report.

The site is a rectangular-shaped parcel that is 37.35± acres in size. The site is currently being utilized as a dairy farm. The northern portion of the site is developed with single family residences and a milk parlor. The residence and milk parlor structures appear to be single-story structures of wood frame and stucco construction and are assumed to be supported on shallow foundations with concrete slab-on-grade floors. The ground surface north of the existing buildings consists of turf grass and exposed soil. Numerous medium- to large-size trees are located along the western border of the site.

Cattle pens occupy the central portion of the site directly south of the existing residence and milk parlor. Metal canopy structures are present in the cattle pen areas. The ground surface cover in the cattle pens generally consists of manure with some areas of exposed soil. The southern 60± percent of the site consists a furrowed field with heavy grass and weed growth. Pipes which are assumed to discharge cattle wash water are present in the northern portion of this area. Stockpiles of manure and other organic materials are present between the cattle pens and the drainage field.

Topographic information was obtained from a plan created by Hillwig-Goodrow, Inc. This plan indicates the existing site topography with occasional spot elevations. The highest spot elevation indicated on the plan is 681.3 feet msl, near the north end of the dairy farm. The lowest elevation indicated on the grading plan is 664.3 ± feet msl is the southern portion of the subject site. Site topography within the subject area generally slopes downward to the south at an approximate gradient of less than 1 percent.

3.2 Proposed Development

Two (2) conceptual site plans, identified as Scheme 1 and Scheme 3, prepared by Herdman Architecture + Design, were provided to our office by the client. Scheme 1 indicates that the subject site will be developed with two (2) commercial/industrial buildings identified as Building 1 and Building 2. Building 1 will be located in the southern half of the site and will be 436,559± ft^2 in size and Building 2 will be located in the northern half of the site and will be 408,360± ft^2 in size. Dock high doors will be constructed along the west side of both buildings. The buildings will be surrounded by asphaltic concrete pavements in the parking and drive lane areas, Portland cement concrete pavements in the loading areas, and landscape planters throughout the site. Scheme 3 indicates that the subject site will be developed with four (4) commercial/industrial buildings identified as Buildings 1 through 4. Building 1 will be located in the southern half of the site and will be 436,559± ft² in size. Building 2 will be located in the north-central area of the site and will be 275,610± ft² in size. Building 3 and Building 4 will be located in the northern area of the site and will be 39,705± ft² and 36,120± ft² in size, respectively. Dock high doors will be constructed along the western side of all of the buildings. The buildings will be surrounded by asphaltic concrete pavements in the parking and drive lane areas, Portland cement concrete pavements in the loading areas, and landscape planters throughout the site.

Detailed structural information has not been provided. We assume that the structures will be of concrete tilt-up construction, typically supported on conventional shallow foundation systems with concrete slab-on-grade floors. Based on the proposed construction, maximum column and wall loads are expected to be on the order of 100 kips and 3 to 5 kips per linear foot, respectively.

Preliminary grading plans were not available at the time of this report. Based on the existing topography, and assuming a relatively balanced site, cuts and fills on the order of 4 to 5± feet are expected to be necessary to achieve the proposed site grades within the proposed building area. The proposed structure is not expected to incorporate any significant below grade construction such as basements or crawl spaces.

4.0 SUBSURFACE EXPLORATION

4.1 Scope of Exploration/Sampling Methods

The subsurface exploration conducted for this project consisted of thirteen (13) borings advanced to depths of 5 to 30± feet below currently existing site grades. In addition to the thirteen borings, six (6) trenches were excavated at the site to depths of 7 to 7½± feet below existing site grades. The trenches were excavated using a backhoe with a 24-inch wide bucket. All of the borings and trenches were logged during exploration by members of our staff.

The borings were advanced with hollow-stem augers, by a limited access drilling rig. Representative bulk and in-situ soil samples were taken during drilling. Relatively undisturbed in-situ samples were taken with a split barrel "California Sampler" containing a series of one inch long, 2.416± inch diameter brass rings. This sampling method is described in ASTM Test Method D-3550. In-situ samples were also taken using a 1.4± inch inside diameter split spoon sampler, in general accordance with ASTM D-1586. Both of these samplers are driven into the ground with successive blows of a 140-pound weight falling 30 inches. The blow counts obtained during driving are recorded for further analysis. Bulk samples were collected in plastic bags to retain their original moisture content. The relatively undisturbed ring samples were placed in molded plastic sleeves that were then sealed and transported to our laboratory.

The approximate locations of the borings and trenches are indicated on the Boring and Trench Location Plan, included as Plate 2A in Appendix A of this report. The boring and trench locations are also indicated on Plate 2B, in Appendix A of this report, which depicts an alternative scheme for the proposed building locations. The Boring and Trench Logs, which illustrate the conditions encountered at the boring and trench locations, as well as the results of some of the laboratory testing, are included in Appendix B.

4.2 Geotechnical Conditions

Manure

Manure was present at the ground surface at Trench Nos. T-1, T-2, T-3, T-4 and Borings Nos. B-2 and B-3 with a thickness of 3 to 6± inches below existing site grades.

Artificial Fill

Artificial fill soils were encountered at the ground surface at Boring Nos. B-2, B-3, B-4 and B-12, and Trench Nos. T-1, T-2 and T-3. The artificial fill soils extend to depths of 1½ to 5½± feet below the existing site grades. The fill soils generally consist of medium dense silty fine sands, fine sandy silts, and fine sands with varying amounts of silt, medium sand, and fine gravel. The fill soils possess a disturbed appearance and some samples contain minor debris, such as asphaltic concrete, plastic, glass, and brick fragments, resulting in their classification as artificial fill.

Alluvium

Native alluvial soils were encountered at all of the borings and trench locations, with the exception of Boring No. B-12, which was terminated in artificial fill materials. The near surface alluvium encountered within the upper 6½ to 12± feet generally consists of loose to medium dense fine sands and silty fine sands. Some of these soils, located within the upper 2½ to 5± feet possess a slightly disturbed appearance. These soils are classified as disturbed alluvium on the boring logs. Medium dense to dense fine sands, silty fine sands, and fine sandy silts were generally encountered at depths greater than 6½ to 12± feet. Occasional stiff to very stiff fine sandy clay and clayey silt layers were also encountered at Boring Nos. B-1 and B-5 at depths of 27 to 30± feet. Very stiff clayey silt layers were encountered at Boring No. B-6 between depths of 17 and 20± feet.

Groundwater

Free water was not encountered during the drilling of any of the borings. Based on the lack of any water within the borings, and the moisture contents of the recovered soil samples, the static groundwater is considered to have existed at a depth in excess of 30± feet at the time of the subsurface exploration.

As part of our research, we reviewed available groundwater data in order to determine regional groundwater depths. Recent water level data was obtained from the California State Water Resources Control Board, GeoTracker website, http://geotracker.waterboards.ca.gov/. Available data for monitoring wells, located approximately within a one-mile radius from the site, indicate high groundwater levels ranging from 62 to 131± feet below ground surface.

5.0 LABORATORY TESTING

The soil samples recovered from the subsurface exploration were returned to our laboratory for further testing to determine selected physical and engineering properties of the soils. The tests are briefly discussed below. It should be noted that the test results are specific to the actual samples tested, and variations could be expected at other locations and depths.

Classification

All recovered soil samples were classified using the Unified Soil Classification System (USCS), in accordance with ASTM D-2488. The field identifications were then supplemented with additional visual classifications and/or by laboratory testing. The USCS classifications are shown on the Boring and Trench Logs and are periodically referenced throughout this report.

Dry Density and Moisture Content

The density has been determined for selected relatively undisturbed ring samples. These densities were determined in general accordance with the method presented in ASTM D-2937. The results are recorded as dry unit weight in pounds per cubic foot. The moisture contents are determined in accordance with ASTM D-2216, and are expressed as a percentage of the dry weight. These test results are presented on the Boring and Trench Logs.

Consolidation

Selected soil samples have been tested to determine their consolidation potential, in accordance with ASTM D-2435. The testing apparatus is designed to accept either natural or remolded samples in a one-inch high ring, approximately 2.416 inches in diameter. Each sample is then loaded incrementally in a geometric progression and the resulting deflection is recorded at selected time intervals. Porous stones are in contact with the top and bottom of the sample to permit the addition or release of pore water. The samples are typically inundated with water at an intermediate load to determine their potential for collapse or heave. The results of the consolidation testing are plotted on Plates C-1 through C-12 in Appendix C of this report.

Soluble Sulfates

Representative samples of the near-surface soils were submitted to a subcontracted analytical laboratory for determination of soluble sulfate content. Soluble sulfates are naturally present in soils, and if the concentration is high enough, can result in degradation of concrete which comes into contact with these soils. The results of the soluble sulfate testing are presented below, and are discussed further in a subsequent section of this report.

Sample Identification	**Soluble Sulfates (%)**	**ACI Classification**
B-3 @ 0 to 5 feet	0.049	Negligible
B-6 @ 0 to 5 feet	0.002	Negligible
B-9 @ 0 to 5 feet	0.001	Negligible

Maximum Dry Density and Optimum Moisture Content

Representative bulk samples was tested to determine their maximum dry densities and optimum moisture contents. The results have been obtained using the Modified Proctor procedure, per ASTM D-1557, and are presented on Plates C-13 and C-14 in Appendix C of this report. This test is generally used for comparison with the in-situ densities of undisturbed field samples, and for later compaction testing. Additional testing of other soil types or soil mixes may be necessary at a later date.

Corrosivity Testing

Three representative bulk samples of the near-surface soils were submitted to a subcontracted corrosion engineering laboratory to determine if the near-surface soils possess corrosive characteristics with respect to common construction materials. The corrosivity testing included a determination of the electrical resistivity, pH, and chloride and nitrate concentrations of the soils, as well as other tests. The results of some of these tests are presented below. A complete presentation of all of the corrosivity test results is included in the Soil Corrosivity Study report, prepared by HDR, included in Appendix F of this report.

Sample Identification	Saturated Resistivity (ohm-cm)	pH	Chlorides (mg/kg)	Nitrates (mg/kg)
B-3 @ 0 to 5 feet	440	7.5	983	16
B-6 @ 0 to 5 feet	3,960	7.3	19	116
B-9 @ 0 to 5 feet	2,200	7.3	52	237

Expansion Index

The expansion potential of the on-site soils was determined in general accordance with ASTM D-4829 as required by the California Building Code (CBC). The testing apparatus is designed to accept a 4-inch diameter, 1-in high, remolded sample. The sample is initially remolded to 50± 1 percent saturation and then loaded with a surcharge equivalent to 144 pounds per square foot. The sample is then inundated with water, and allowed to swell against the surcharge. The resultant swell or consolidation is recorded after a 24-hour period. The result of the EI testing is as follows:

Sample Identification	Expansion Index	Expansive Potential
T-4 @ 0 to 5 feet	6	Very Low

Organic Content Testing

Several samples of the near surface soils were tested to determine their organic contents, in accordance with ASTM Test Method D-2974. The results of the testing are as follows:

Sample Identification	Organic Content (%)
T-1 @ 0 to 3 inches	6.9
T-1 @ 3 to 6 inches	1.4

Sample Identification	Organic Content (%)
T-1 @ 6 to 9 inches	1.9
T-1 @ 9 to 12 inches	2.1
T-1 @ 12 to 15 inches	6.2
T-1 @ 15 to 18 inches	2.0
T-2 @ 0 to 6 inches	9.3
T-2 @ 6 to 12 inches	3.2
T-2 @ 12 to 18 inches	2.3
T-2 @ 18 to 24 inches	1.2
T-3 @ 0 to 6 inches	5.8
T-3 @ 6 to 12 inches	0.8
T-3 @ 12 to 18 inches	1.3
T-3 @ 18 to 24 inches	0.9
T-4 @ 0 to 6 inches	46.2
T-4 @ 6 to 12 inches	16.6
T-4 @ 12 to 18 inches	9.2
T-4 @ 18 to 24 inches	5.1

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our review, field exploration, laboratory testing and geotechnical analysis, the proposed development is considered feasible from a geotechnical standpoint. The recommendations contained in this report should be taken into the design, construction, and grading considerations. The recommendations are contingent upon all grading and foundation construction activities being monitored by the geotechnical engineer of record. The Grading Guide Specifications, included as Appendix D, should be considered part of this report, and should be incorporated into the project specifications. The contractor and/or owner of the development should bring to the attention of the geotechnical engineer any conditions that differ from those stated in this report, or which may be detrimental for the development.

6.1 Seismic Design Considerations

The subject site is located in an area which is subject to strong ground motions due to earthquakes. The performance of a site specific seismic hazards analysis was beyond the scope of this investigation. However, numerous faults capable of producing significant ground motions are located near the subject site. Due to economic considerations, it is not generally considered reasonable to design a structure that is not susceptible to earthquake damage. Therefore, significant damage to structures may be unavoidable during large earthquakes. The proposed structures should, however, be designed to resist structural collapse and thereby provide reasonable protection from serious injury, catastrophic property damage and loss of life.

Faulting and Seismicity

Research of available maps indicates that the subject site is not located within an Alquist-Priolo Earthquake Fault Zone. Furthermore, SCG did not identify any evidence of faulting during the geotechnical investigation. Therefore, the possibility of significant fault rupture on the site is considered to be low.

Seismic Design Parameters

Based on the standards in place at the time of this report, it is expected that the proposed development at this site will be designed in accordance with the 2016 California Building Code (CBC). The CBC provides procedures for earthquake resistant structural design that include considerations for on-site soil conditions, occupancy, and the configuration of the structure including the structural system and height. The seismic design parameters presented below are based on the soil profile and the proximity of known faults with respect to the subject site.

The 2016 CBC Seismic Design Parameters have been generated using U.S. Seismic Design Maps, a web-based software application developed by the United States Geological Survey. This software application, available at the USGS web site, calculates seismic design parameters in accordance with the 2016 CBC, utilizing a database of deterministic site accelerations at 0.01 degree intervals. The table below is a compilation of the data provided by the USGS application. A copy of the output generated from this program is included in Appendix E of this report. A copy of the Design Response Spectrum, as generated by the USGS application is also included in Appendix E. Based on this output, the following parameters may be utilized for the subject site:

2016 CBC SEISMIC DESIGN PARAMETERS

Parameter		Value
Mapped Spectral Acceleration at 0.2 sec Period	S_S	1.500
Mapped Spectral Acceleration at 1.0 sec Period	S_1	0.600
Site Class	---	D
Site Modified Spectral Acceleration at 0.2 sec Period	S_{MS}	1.500
Site Modified Spectral Acceleration at 1.0 sec Period	S_{M1}	0.900
Design Spectral Acceleration at 0.2 sec Period	S_{DS}	1.000
Design Spectral Acceleration at 1.0 sec Period	S_{D1}	0.600

Liquefaction

Liquefaction is the loss of strength in generally cohesionless, saturated soils when the pore-water pressure induced in the soil by a seismic event becomes equal to or exceeds the overburden pressure. The primary factors which influence the potential for liquefaction include groundwater table elevation, soil type and plasticity characteristics, relative density of the soil, initial confining pressure, and intensity and duration of ground shaking. The depth within which the occurrence of liquefaction may impact surface improvements is generally identified as the upper 50 feet below the existing ground surface. Liquefaction potential is greater in saturated, loose, poorly graded fine sands with a mean (d_{50}) grain size in the range of 0.075 to 0.2 mm (Seed and Idriss, 1971). Non-sensitive clayey (cohesive) soils which possess a plasticity index of at least 18 (Bray and Sancio, 2006) are generally not considered to be susceptible to liquefaction, nor are those soils which are above the historic static groundwater table.

The California Geological Survey (CGS) has not yet conducted detailed seismic hazards mapping in the area of the subject site. The general liquefaction susceptibility of the site was attempted to be determined by research of the San Bernardino County Land Use Plan, General Plan, Geologic Hazard Overlay. No geologic hazard overlay was available for the Corona North Quadrangle at the time of this report. The general plan update website indicates that if a geologic hazard map overlay does not exist, then there are no geologic hazards mapped by the state or county present in that community. Therefore, the subject site is not in a mapped geologic hazard zone. Furthermore, available groundwater data within a one mile radius from the site indicate high groundwater levels ranging from 62 to 131± feet. Based on the subsurface conditions encountered at the boring locations and the lack of groundwater within 50± feet of the ground surface, liquefaction is not considered to be a design concern for this project.

6.2 Geotechnical Design Considerations

General

The active cattle pen areas and the southeastern portion of the site are covered with manure at the ground surface, with thicknesses of 3 to 12± inches. All of the manure and any organic topsoil should be removed and exported from the site.

A surficial layer of fill soils was encountered at some of the boring and trench locations, ranging in thicknesses from 1½ to 5½± feet. These fill materials are somewhat variable in composition and strength, and occasional samples possess trace amounts of artificial debris. Based on these characteristics and the lack of any documentation regarding the placement or compaction of the fill soils, the near-surface fill soils are considered to represent undocumented fill. The near-surface native soils consist of loose to medium dense alluvial sands and silty sands. Based on the results of laboratory testing, these soils possess variable densities. Neither the undocumented fill soils nor the near surface native alluvium are considered suitable to support the foundations loads of the new buildings, in their present condition. Therefore, remedial grading is considered warranted within the proposed building areas in order to remove and replace the artificial fill soils and a portion of the near surface alluvial soils as compacted structural fill.

Significant demolition will also be required in the northern portion of this site. The recommended remedial grading should also remove any soils disturbed during the demolition of the existing structures from the proposed building areas.

Very moist soils were encountered in the furrowed area of the southern portion of the site, where cattle wash-water is discharged. This condition is expected to improve after the dairy closes. However, some of the soils encountered at the base of the recommended overexcavations within the building pad areas near the southern portion of the site may possess elevated moisture contents. Some drying of the overexcavation subgrade and excavated soils may be necessary, prior to compaction as structural fill.

Settlement

The proposed remedial grading will remove a portion of the loose, low strength, and potentially compressible native alluvial soils, and all of the artificial fill materials, and replace these materials as compacted structural fill. The native soils that will remain in place below the recommended depth of overexcavation will not be subject to significant load increases from the foundations of the new structure. Provided that the recommended remedial grading is completed, the post-construction static settlements of the proposed structure are expected to be within tolerable limits.

Soluble Sulfates

The results of the soluble sulfate testing indicate that the selected samples of the on-site soils contain negligible concentrations of soluble sulfates with respect to the American Concrete Institute (ACI) Publication 318-14 Building Code Requirements for Structural Concrete and Commentary, Section 4.3. Therefore, specialized concrete mix designs are not considered to be necessary, with regard to sulfate protection purposes. It is, however, recommended that additional soluble sulfate testing be conducted at the completion of rough grading to verify the soluble sulfate concentrations of the soils which are present at pad grade within the building areas.

Expansion

Laboratory testing performed on a representative sample of the near surface soils indicates that these materials possess very low expansion potential (EI = 15). Based on this test result, no design considerations related to expansive soils are considered warranted for this site. It is recommended that additional expansion index testing be conducted during subsequent geotechnical investigation and at the completion of rough grading to verify the expansion potential of the as-graded building pad.

Corrosion Potential

Based on the subject sites present use as a dairy farm, three samples of the near-surface soils were submitted to a corrosion engineer for analytical testing. The results of these tests and the corrosion engineer's recommendations are presented in a soil Corrosivity Study, prepared by HDR, included within Appendix F of this report. The report indicates that some of the on-site soils possess potentially corrosive chloride and nitrate concentrations with respect to the common building materials. Some of the soils also possess very low electrical resistivity, which also indicates potential for the on-site soils to be corrosive to metallic improvements. The Soil Corrosivity Study contains a more detailed interpretation of the test results along with recommendations for the protection of new improvements constructed at the site.

Organic Content

Organic content testing was performed on samples taken from the exploratory trenches in the cattle pen areas and the furrowed areas in the southern portion of the site. These tests were performed on soils located beneath the manure, which was visually determined to be highly organic. Two samples from the upper 12± inches at Trench No. T-4 possessed relatively high organic contents of 46.2 percent and 16.6 percent. However, all of the other samples taken from the upper 24± inches at the trench locations possess moderate organic contents ranging between 0.8 and 9.3 percent.

It is recommended that all manure and any organic topsoil be removed during site stripping. Additionally, soils observed to possess appreciable organic material, such as those from the upper 1± foot at Trench No. T-4, should also be removed during site stripping. Subsequent to stripping of the organic materials at the site, the remaining soils in the upper 24± inches are expected to possess minor to moderate organic contents of about 1 to 9± percent. Soils possessing minor to moderate organic contents, less than 10 percent by weight, may be blended with less-organic on-site soils, provided that the final mixture contains less than 3 percent organics by weight. This will require the grading contractor to thoroughly blend the near surface soils (from the upper 1½ to 2± feet) with deeper, relatively non-organic soils prior to placement as structural fill. Additional stripping of soils present in the upper 6± inches below the ground surface could also help to facilitate the blending of the minor to moderately organic soils, since the soils possessing the highest organic contents were generally located within the upper 6± inches.

Based on the results of laboratory testing, it is considered feasible to reuse the near surface soils in structural fills, provided that these soils are cleaned of all apparent vegetation and any highly organic material, if present.

Shrinkage/Subsidence

Removal and recompaction of the near surface fill and/or alluvial soils is estimated to result in an average shrinkage of 7 to 12 percent. Minor ground subsidence is expected to occur in the soils below the zone of removal, due to settlement and machinery working. The subsidence is estimated to be 0.1± feet. This estimate may be used for grading in areas that are underlain by native alluvial soils.

These estimates are based on previous experience and the subsurface conditions encountered at the boring locations. The actual amount of subsidence is expected to be variable and will be dependent on the type of machinery used, repetitions of use, and dynamic effects, all of which are difficult to assess precisely.

Grading and Foundation Plan Review

No grading or foundation plans were available at the time of this report. It is therefore recommended that we be provided with copies of the preliminary plans, when they become available, for review with regard to the conclusions, recommendations, and assumptions contained within this report.

6.3 Site Grading Recommendations

The grading recommendations presented below are based on the subsurface conditions encountered at the boring and trench locations and our understanding of the proposed development. We recommend that all grading activities be completed in accordance with the Grading Guide Specifications included as Appendix D of this report, unless superseded by site-specific recommendations presented below.

Site Stripping and Demolition

Initial site preparation should include stripping of any topsoil, vegetation and organic debris on the site. Based on conditions observed at the time of the subsurface exploration, this will include localized areas of manure, shrubs, grasses and trees. These materials should be disposed of off-site. The actual extent of stripping should be determined in the field by a representative of the geotechnical engineer, based on the organic content and the stability of the encountered materials.

The proposed development will require demolition of the existing buildings, dairy structures and pavements. Additionally, any existing improvements that will not remain in place for use with the new development should be removed in their entirety. This should include all foundations, floor slabs, utilities, and any other subsurface improvements associated with the existing structures. The existing pavements are not expected to be reused with the new development. Debris resultant from demolition should be disposed of offsite. Alternatively, concrete and asphalt debris may be pulverized to a maximum 2-inch particle size, well mixed with the on-site soils, and incorporated into new structural fills or it may be crushed and made into CMB, if desired.

Treatment of Existing Soils: Building Pads

Remedial grading will be necessary within the proposed building pad areas to remove a portion of the near surface alluvial soils, all of the artificial fill, and any soils disturbed during demolition/site stripping. Based on conditions encountered at the boring and trench locations, artificial fill soils extend to depths of 1½ to 5½± feet in localized areas. At a minimum, the overexcavation is recommended to extend to a depth of at least 3 feet below existing grade and 2 feet below proposed building pad subgrade elevations, whichever is greater. In addition, the overexcavation should extend to a depth of at least 3 feet below the proposed foundation bearing grade within the influence zones of the new foundations.

The overexcavation areas should extend at least 5 feet beyond the building perimeters and foundations, and to an extent equal to the depth of fill below the new foundations. If the proposed structure incorporates any exterior columns (such as for a canopy or overhang) the overexcavation should also encompass these areas.

After a suitable overexcavation subgrade has been achieved, the exposed soils should be scarified to a depth of at least 12 inches, moisture treated to 2 to 4 percent above optimum, and recompacted. The previously excavated soils may then be replaced as compacted structural fill, with exception to any buried organic materials.

Treatment of Existing Soils: Retaining Walls and Site Walls

Although not indicated on the site plan, it may be necessary to construct some small retaining walls or site walls at or near the existing surface grade. The existing soils within the areas of any proposed retaining and site walls should be overexcavated to a depth of 2 feet below foundation bearing grade and replaced as compacted structural fill as discussed above for the proposed building pad. Any undocumented fill soils within any of these foundation areas should be removed in their entirety. The overexcavation subgrade soils should be evaluated by the geotechnical engineer prior to scarifying, moisture conditioning, and recompacting the upper 12 inches of exposed subgrade soils, as discussed for the building area. The previously excavated soils may then be replaced as compacted structural fill.

Treatment of Existing Soils: Parking Areas

Based on economic considerations, overexcavation of the existing soils in the new parking and drive areas is not considered warranted, with the exception of areas where lower strength or unstable soils are identified by the geotechnical engineer during grading.

Subgrade preparation in the new parking and drive areas should initially consist of removal of all soils disturbed during stripping and demolition operations. The geotechnical engineer should then evaluate the subgrade to identify any areas of additional unsuitable soils. The subgrade soils should then be scarified to a depth of 12± inches, moisture conditioned to 2 to 4 percent above optimum, and recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. Based on the presence of variable strength alluvial soils throughout the site, it is expected that some isolated areas of additional overexcavation may be required to remove zones of lower strength, unsuitable soils.

The grading recommendations presented above for the proposed parking and drive areas assume that the owner and/or developer can tolerate minor amounts of settlement within the proposed parking areas. The grading recommendations presented above do not completely mitigate the extent of the existing variable strength alluvium and undocumented fill soils which are present in isolated areas of the site. As such, settlement and associated pavement distress could occur. Typically, repair of such distressed areas involves significantly lower costs than completely mitigating these soils at the time of construction. If the owner cannot tolerate the risk of such settlements, the parking and drive areas should be overexcavated to a depth of 2 feet below proposed pavement subgrade elevation, with the resulting soils replaced as compacted structural fill.

Fill Placement

- Fill soils should be placed in thin (6± inches), near-horizontal lifts, moisture conditioned to 2 to 4 percent of the optimum moisture content, and compacted.
- On-site soils may be used for fill provided they are cleaned of any debris to the satisfaction of the geotechnical engineer. All grading and fill placement activities should be completed in accordance with the requirements of the CBC and the grading code of the city of Ontario.
- All fill soils should be compacted to at least 90 percent of the ASTM D-1557 maximum dry density. Fill soils should be well mixed.
- Compaction tests should be performed periodically by the geotechnical engineer as random verification of compaction and moisture content. These tests are intended to aid the contractor. Since the tests are taken at discrete locations and depths, they may not be indicative of the entire fill and therefore should not relieve the contractor of his responsibility to meet the job specifications.

Imported Structural Fill

All imported structural fill should consist of very low to non-expansive (EI < 20), well graded soils possessing at least 10 percent fines (that portion of the sample passing the No. 200 sieve). Additional specifications for structural fill are presented in the Grading Guide Specifications, included as Appendix D.

Utility Trench Backfill

In general, all utility trench backfill soils should be compacted to at least 90 percent of the ASTM D-1557 maximum dry density. As an alternative, a clean sand (minimum Sand Equivalent of 30) may be placed within trenches and compacted in place (jetting or flooding is not recommended). Compacted trench backfill should conform to the requirements of the local grading code, and more restrictive requirements may be indicated by the city of Ontario. All utility trench backfills should be witnessed by the geotechnical engineer. The trench backfill soils should be compaction tested where possible; probed and visually evaluated elsewhere.

Utility trenches which parallel a footing, and extending below a 1h:1v plane projected from the outside edge of the footing should be backfilled with structural fill soils, compacted to at least 90 percent of the ASTM D-1557 standard. Pea gravel backfill should not be used for these trenches.

6.4 Construction Considerations

Excavation Considerations

The near surface soils generally consist of fine sands, silty sands, and sandy silts. These materials are likely to be subject to caving within shallow excavations. Where caving occurs within shallow excavations, flattened excavation slopes may be sufficient to provide excavation stability. On a preliminary basis, temporary excavation slopes should be made no steeper than 2h:1v. Deeper excavations may require some form of external stabilization such as shoring or bracing. Maintaining adequate moisture content within the near-surface soils will improve excavation stability. All excavation activities on this site should be conducted in accordance with Cal-OSHA regulations.

Moisture Sensitive Subgrade Soils

Some of the near surface soils possess appreciable silt content. These soils may become unstable if exposed to significant moisture infiltration or disturbance by construction traffic. In addition, based on their granular content, some of the on-site soils will also be susceptible to erosion. The site should, therefore, be graded to prevent ponding of surface water and to prevent water from running into excavations.

Groundwater

Based on the conditions encountered in the borings, groundwater is not present within 30± feet of the ground surface. Based on the anticipated depth to groundwater, it is not expected that the groundwater will affect excavations for the foundations or utilities.

6.5 Foundation Design and Construction

Based on the preceding grading recommendations, it is assumed that the new building pads will be underlain by structural fill soils extending to depths of at least 2 feet below foundation bearing grade. Based on this subsurface profile, the proposed structures may be supported on conventional shallow foundations.

Foundation Design Parameters

New square and rectangular footings may be designed as follows:

- Maximum, net allowable soil bearing pressure: 2,500 lbs/ft^2.
- Minimum wall/column footing width: 14 inches/24 inches.
- Minimum longitudinal steel reinforcement within strip footings: Four (4) No. 5 rebars (2 top and 2 bottom).

- Minimum foundation embedment: 12 inches into suitable structural fill soils, and at least 18 inches below adjacent exterior grade. Interior column footings may be placed immediately beneath the floor slab.

- It is recommended that the perimeter building foundations be continuous across all exterior doorways. Any flatwork adjacent to the exterior doors should be doweled into the perimeter foundations in a manner determined by the structural engineer.

The allowable bearing pressures presented above may be increased by 1/3 when considering short duration wind or seismic loads. The minimum steel reinforcement recommended above is based on standard geotechnical practice. Additional rigidity may be necessary for structural considerations. The actual design of the foundations should be determined by the structural engineer.

Foundation Construction

The foundation subgrade soils should be evaluated at the time of overexcavation, as discussed in Section 6.3 of this report. It is further recommended that the foundation subgrade soils be evaluated by the geotechnical engineer immediately prior to steel or concrete placement. Soils suitable for direct foundation support should consist of newly placed structural fill compacted at least 90 percent of the ASTM D-1557 maximum dry density. Any unsuitable materials should be removed to a depth of suitable bearing compacted structural fill, with the resulting excavations backfilled with compacted fill soils. As an alternative, lean concrete slurry (500 to 1,500 psi) may be used to backfill such isolated overexcavations.

The foundation subgrade soils should also be properly moisture conditioned to 2 to 4 percent above the Modified Proctor optimum, to a depth of at least 12 inches below bearing grade. Since it is typically not feasible to increase the moisture content of the floor slab and foundation subgrade soils once rough grading has been completed, care should be taken to maintain the moisture content of the building pad subgrade soils throughout the construction process.

Estimated Foundation Settlements

Post-construction total and differential static settlements of shallow foundations designed and constructed in accordance with the previously presented recommendations are estimated to be less than 1.0 and 0.5 inches, respectively, under static conditions. Differential movements are expected to occur over a 30-foot span, thereby resulting in an angular distortion of less than 0.002 inches per inch.

Lateral Load Resistance

Lateral load resistance will be developed by a combination of friction acting at the base of foundations and slabs and the passive earth pressure developed by footings below grade. The following friction and passive pressure may be used to resist lateral forces:

- Passive Earth Pressure: 300 lbs/ft^3
- Friction Coefficient: 0.3

These are allowable values, and include a factor of safety. When combining friction and passive resistance, the passive pressure component should be reduced by one-third. These values assume that footings will be poured directly against compacted structural fill soils. The maximum allowable passive pressure is 2,500 lbs/ft^2.

6.6 Floor Slab Design and Construction

Subgrades which will support new floor slabs should be prepared in accordance with the recommendations contained in the ***Site Grading Recommendations*** section of this report. Preliminarily, the floors of the proposed structures may be constructed as conventional slabs-on-grade supported on newly placed structural fill. Based on geotechnical considerations, the floor slabs may be designed as follows:

- Minimum slab thickness: 6 inches.
- Modulus of Subgrade Reaction: k = 125 psi/in.
- Minimum slab reinforcement: Not required for geotechnical considerations. The actual floor slab reinforcement should be determined by the structural engineer, based upon the imposed loading.
- Slab underlayment: If moisture sensitive floor coverings will be used then minimum slab underlayment should consist of a moisture vapor barrier constructed below the entire area of the proposed slab where such moisture sensitive floor coverings are anticipated. The moisture vapor barrier should meet or exceed the Class A rating as defined by ASTM E 1745-97 and have a permeance rating less than 0.01 perms as described in ASTM E 96-95 and ASTM E 154-88. A polyolefin material such as Stego® Wrap Vapor Barrier or equivalent will meet these specifications. The moisture vapor barrier should be properly constructed in accordance with all applicable manufacturer specifications. Given that a rock free subgrade is anticipated and that a capillary break is not required, sand below the barrier is not required. The need for sand and/or the amount of sand above the moisture vapor barrier should be specified by the structural engineer or concrete contractor. The selection of sand above the barrier is not a geotechnical engineering issue and hence outside our purview. Where moisture sensitive floor coverings are not anticipated, the vapor barrier may be eliminated.
- Moisture condition the floor slab subgrade soils to 2 to 4 percent above the Modified Proctor optimum moisture content, to a depth of 12 inches. The moisture content of the floor slab subgrade soils should be verified by the geotechnical engineer within 24 hours prior to concrete placement.
- Proper concrete curing techniques should be utilized to reduce the potential for slab curling or the formation of excessive shrinkage cracks.

The actual design of the floor slab should be completed by the structural engineer to verify adequate thickness and reinforcement.

6.7 Retaining Wall Design and Construction

Although not indicated on the site plan, the proposed development may require some small retaining walls to facilitate the new site grades and in loading docks. Retaining walls are also expected within the truck dock areas of the proposed building. The parameters recommended for use in the design of these walls are presented below.

Retaining Wall Design Parameters

Based on the soil conditions encountered at the boring locations, the following parameters may be used in the design of new retaining walls for this site. The following parameters assume that only the on-site soils will be utilized for retaining wall backfill. The on-site soils generally consist of silty sands, sandy silts and fine sands. Based on their composition, the on-site soils have been assigned a friction angle of 30 degrees.

If desired, SCG could provide design parameters for an alternative select backfill material behind the retaining walls. The use of select backfill material could result in lower lateral earth pressures. In order to use the design parameters for the imported select fill, this material must be placed within the entire active failure wedge. This wedge is defined as extending from the heel of the retaining wall upwards at an angle of approximately 60° from horizontal. If select backfill material behind the retaining wall is desired, SCG should be contacted for supplementary recommendations.

RETAINING WALL DESIGN PARAMETERS

Design Parameter		Soil Type On-site Silty Sands and Sandy Silts
Internal Friction Angle (ϕ)		30°
Unit Weight		125 lbs/ft^3
Equivalent Fluid Pressure:	Active Condition (level backfill)	42 lbs/ft^3
	Active Condition (2h:1v backfill)	67 lbs/ft^3
	At-Rest Condition (level backfill)	63 lbs/ft^3

Regardless of the backfill type, the walls should be designed using a soil-footing coefficient of friction of 0.3 and an equivalent passive pressure of 300 lbs/ft^3. The structural engineer should incorporate appropriate factors of safety in the design of the retaining walls.

The active earth pressure may be used for the design of retaining walls that do not directly support structures or support soils that in turn support structures and which will be allowed to deflect. The at-rest earth pressure should be used for walls that will not be allowed to deflect such as those which will support foundation bearing soils, or which will support foundation loads directly.

Where the soils on the toe side of the retaining wall are not covered by a "hard" surface such as a structure or pavement, the upper 1 foot of soil should be neglected when calculating passive resistance due to the potential for the material to become disturbed or degraded during the life of the structure.

Retaining Wall Foundation Design

The retaining wall foundations should be supported within newly placed compacted structural fill, extending to a depth of at least 2 feet below the proposed bearing grade. Foundations to support new retaining walls should be designed in accordance with the general Foundation Design Parameters presented in a previous section of this report.

Backfill Material

On-site soils may be used to backfill the retaining walls. However, all backfill material placed within 3 feet of the back wall face should have a particle size no greater than 3 inches. The retaining wall backfill materials should be well graded.

It is recommended that a properly installed prefabricated drainage composite such as the MiraDRAIN 6000XL (or approved equivalent), which is specifically designed for use behind retaining walls be used. If the drainage composite material is not covered by an impermeable surface, such as a structure or pavement, a 12-inch thick layer of a low permeability soil should be placed over the backfill to reduce surface water migration to the underlying soils. The drainage composite should be separated from the backfill soils by a suitable geotextile, approved by the geotechnical engineer.

All retaining wall backfill should be placed and compacted under engineering controlled conditions in the necessary layer thicknesses to ensure an in-place density between 90 and 93 percent of the maximum dry density as determined by the Modified Proctor test (ASTM D1557). Care should be taken to avoid over-compaction of the soils behind the retaining walls, and the use of heavy compaction equipment should be avoided.

Seismic Lateral Earth Pressures

In accordance with the 2016 CBC, any retaining walls more than 6 feet in height must be designed for seismic lateral earth pressures. If walls 6 feet or more are required for this site, the geotechnical engineer should be contacted for supplementary seismic lateral earth pressure recommendations.

Subsurface Drainage

As previously indicated, the retaining wall design parameters are based upon drained backfill conditions. Consequently, some form of permanent drainage system will be necessary in conjunction with the appropriate backfill material. Subsurface drainage may consist of either:

- A weep hole drainage system typically consisting of a series of 4-inch diameter holes in the wall situated slightly above the ground surface elevation on the exposed side of the wall and at an approximate 8-foot on-center spacing. The weep holes should include a 2 cubic foot pocket of open graded gravel, surrounded by an approved geotextile fabric, at each weep hole location.

- A 4-inch diameter perforated pipe surrounded by 2 cubic feet of gravel per linear foot of drain placed behind the wall, above the retaining wall footing. The gravel layer should be wrapped in a suitable geotextile fabric to reduce the potential for migration of fines. The footing drain should be extended to daylight or tied into a storm drainage system.

6.8 Pavement Design Parameters

Site preparation in the pavement area should be completed as previously recommended in the Site Grading Recommendations section of this report. The subsequent pavement recommendations assume proper drainage and construction monitoring, and are based on either PCA or CALTRANS design parameters for a twenty (20) year design period. However, these designs also assume a routine pavement maintenance program to obtain the anticipated 20-year pavement service life.

Pavement Subgrades

It is anticipated that the new pavements will be supported on the existing fill and/or native soils that have been scarified, moisture conditioned, and recompacted. These materials generally consist of sands and silty fine sands. Following the completion of grading, these on-site sands and silty sands are expected to exhibit good pavement support characteristics with R-values ranging from 40 to 50. Since R-value testing was not included in the scope of services for this study, the subsequent pavement designs are based upon a conservatively assumed R-value of 40. Any fill material imported to the site should have support characteristics equal to or greater than that of the on-site soils and be placed and compacted under engineering controlled conditions. It may be desirable to perform R-value testing after the completion of rough grading to verify the R-value of the as-graded parking subgrade.

Asphaltic Concrete

Presented below are the recommended thicknesses for new flexible pavement structures consisting of asphaltic concrete over a granular base. The pavement designs are based on the traffic indices (TI's) indicated. The client and/or civil engineer should verify that these TI's are representative of the anticipated traffic volumes. If the client and/or civil engineer determine that the expected traffic volume will exceed the applicable traffic index, we should be contacted for supplementary recommendations. The design traffic indices equate to the following approximate daily traffic volumes over a 20 year design life, assuming six operational traffic days per week.

Traffic Index	No. of Heavy Trucks per Day
4.0	0
5.0	1
6.0	3
7.0	11
8.0	35
9.0	93

For the purpose of the traffic volumes indicated above, a truck is defined as a 5-axle tractor trailer unit with one 8-kip axle and two 32-kip tandem axles. All of the traffic indices allow for 1,000 automobiles per day.

ASPHALT PAVEMENTS (R = 40)					
Materials	**Thickness (inches)**				
	Auto Parking and Auto Drive Lanes (TI = 4.0 to 5.0)	Truck Traffic			
		TI = 6.0	TI = 7.0	TI = 8.0	TI = 9.0
Asphalt Concrete	3	3½	4	5	5½
Aggregate Base	4	6	7	8	10
Compacted Subgrade	12	12	12	12	12

The aggregate base course should be compacted to at least 95 percent of the ASTM D-1557 maximum dry density. The asphaltic concrete should be compacted to at least 95 percent of the Marshall maximum density, as determined by ASTM D-2726. The aggregate base course may consist of crushed aggregate base (CAB) or crushed miscellaneous base (CMB), which is a recycled gravel, asphalt and concrete material. The gradation, R-Value, Sand Equivalent, and Percentage Wear of the CAB or CMB should comply with appropriate specifications contained in the current edition of the "Greenbook" Standard Specifications for Public Works Construction.

Portland Cement Concrete

The preparation of the subgrade soils within concrete pavement areas should be performed as previously described for proposed asphalt pavement areas. The minimum recommended thicknesses for the Portland Cement Concrete pavement sections are as follows:

PORTLAND CEMENT CONCRETE PAVEMENTS				
Materials	**Thickness (inches)**			
	Autos and Light Truck Traffic (TI = 6.0)	Truck Traffic		
		TI = 7.0	TI = 8.0	TI = 9.0
PCC	5	6½	8	9
Compacted Subgrade (95% minimum compaction)	12	12	12	12

The concrete should have a 28-day compressive strength of at least 3,000 psi. The maximum joint spacing within all of the PCC pavements is recommended to be equal to or less than 30 times the pavement thickness. The actual joint spacing and reinforcing of the Portland cement concrete pavements should be determined by the structural engineer.

7.0 GENERAL COMMENTS

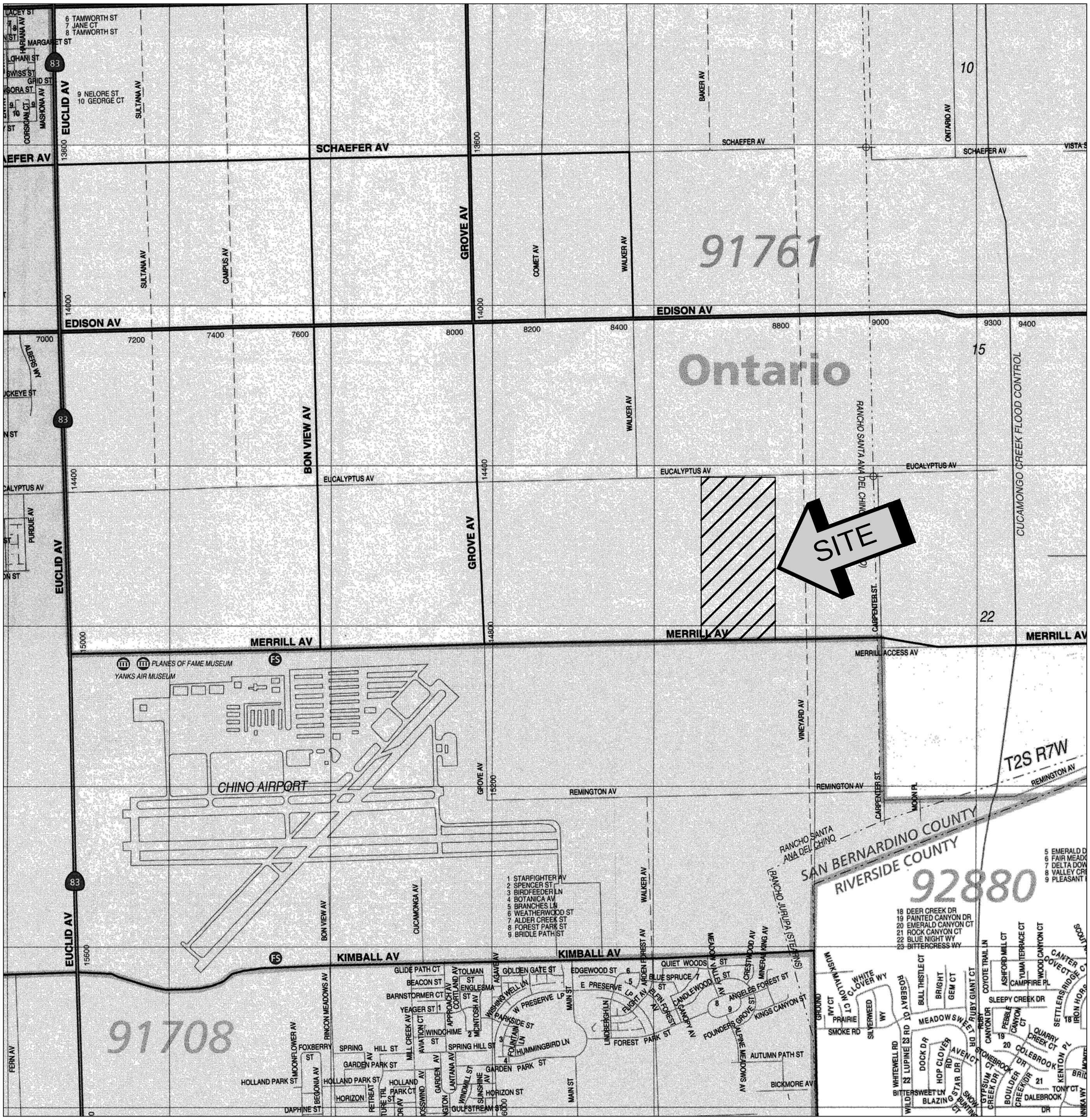
This report has been prepared as an instrument of service for use by the client, in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. This report may be provided to the contractor(s) and other design consultants to disclose information relative to the project. However, this report is not intended to be utilized as a specification in and of itself, without appropriate interpretation by the project architect, civil engineer, and/or structural engineer. The reproduction and distribution of this report must be authorized by the client and Southern California Geotechnical, Inc. Furthermore, any reliance on this report by an unauthorized third party is at such party's sole risk, and we accept no responsibility for damage or loss which may occur. The client(s)' reliance upon this report is subject to the Engineering Services Agreement, incorporated into our proposal for this project.

The analysis of this site was based on a subsurface profile interpolated from limited discrete soil samples. While the materials encountered in the project area are considered to be representative of the total area, some variations should be expected between boring locations and sample depths. If the conditions encountered during construction vary significantly from those detailed herein, we should be contacted immediately to determine if the conditions alter the recommendations contained herein.

This report has been based on assumed or provided characteristics of the proposed development. It is recommended that the owner, client, architect, structural engineer, and civil engineer carefully review these assumptions to ensure that they are consistent with the characteristics of the proposed development. If discrepancies exist, they should be brought to our attention to verify that they do not affect the conclusions and recommendations contained herein. We also recommend that the project plans and specifications be submitted to our office for review to verify that our recommendations have been correctly interpreted.

The analysis, conclusions, and recommendations contained within this report have been promulgated in accordance with generally accepted professional geotechnical engineering practice. No other warranty is implied or expressed.

APPENDIX A



SOURCE: SAN BERNARDINO COUNTY
THOMAS GUIDE, 2013

SITE LOCATION MAP

PROPOSED COMMERCIAL/INDUSTRIAL DEVELOPMENT

ONTARIO, CALIFORNIA

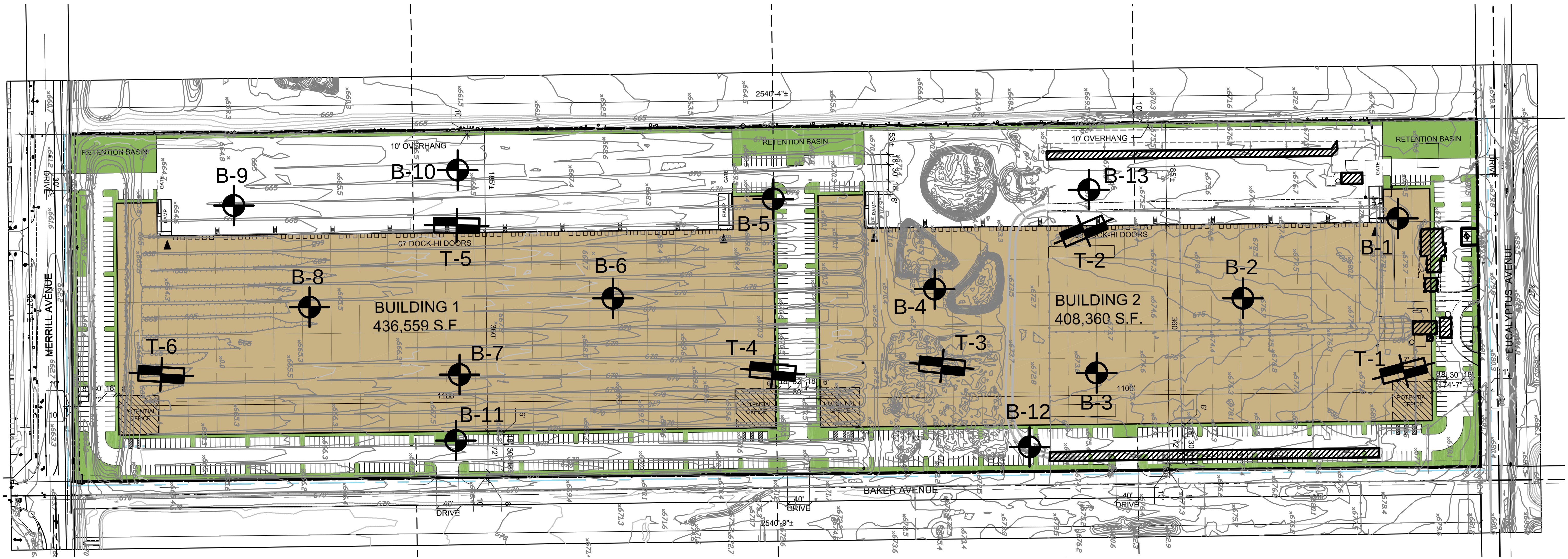
SCALE: 1" = 2400'

DRAWN: AL
CHKD: RGT

SCG PROJECT
17G129-1

PLATE 1

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL



GEOTECHNICAL LEGEND

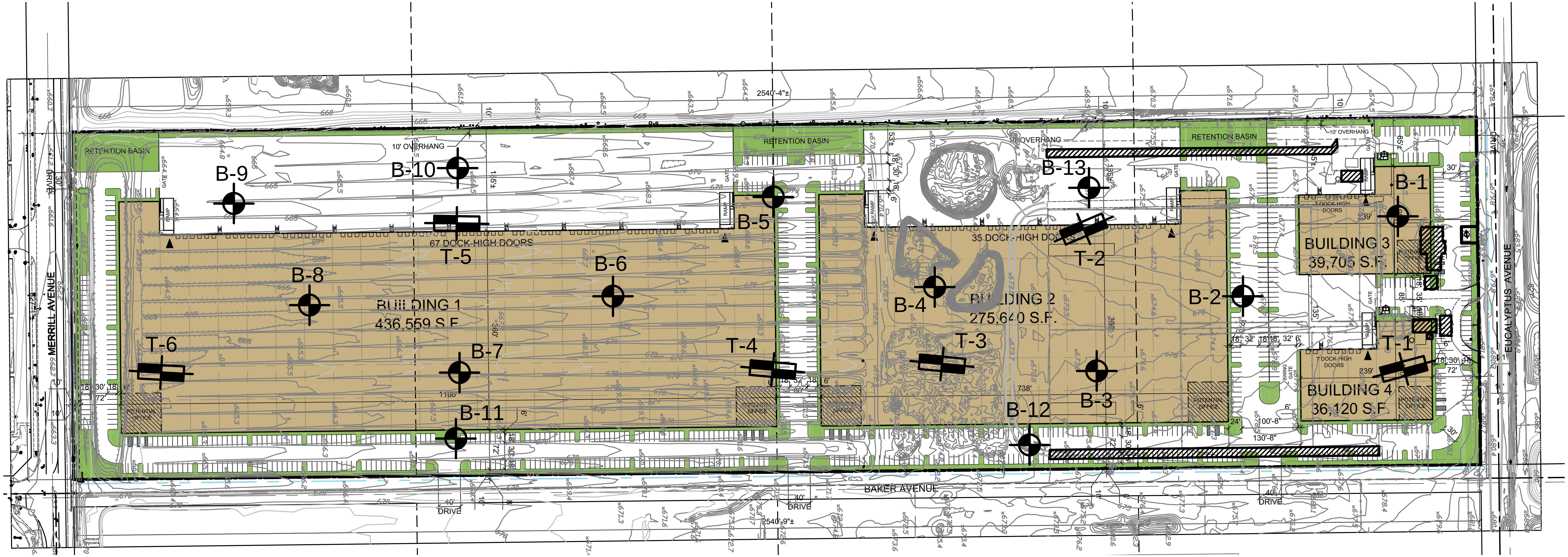
- APPROXIMATE BORING LOCATION
- APPROXIMATE TRENCH LOCATION
- STRUCTURES TO BE DEMOLISHED

NORTH
SoCalGeo

NOTE: ALTA MAP PREPARED BY HILLWIG - GOODROW, INC.

BORING AND TRENCH LOCATION PLAN
PROPOSED COMMERCIAL/INDUSTRIAL DEVELOPMENT
ONTARIO, CALIFORNIA

SCALE: 1" = 180'	SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: JLL CHKD: RGT	
SCG PROJECT 17G129-1	
PLATE 2A	



GEOTECHNICAL LEGEND

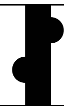
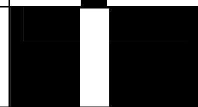
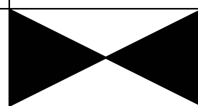
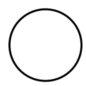
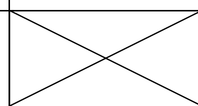
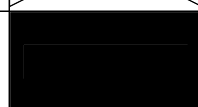
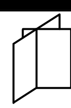
- APPROXIMATE BORING LOCATION
- APPROXIMATE TRENCH LOCATION
- STRUCTURES TO BE DEMOLISHED

NOTE: ALTA MAP PREPARED BY HILLWIG - GOODROW, INC.

BORING AND TRENCH LOCATION PLAN	
PROPOSED COMMERCIAL/INDUSTRIAL DEVELOPMENT	
ONTARIO, CALIFORNIA	
SCALE: 1" = 180'	SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: JLL CHKD: RGT	
SCG PROJECT 17G129-1	
PLATE 2B	

APPENDIX B

BORING LOG LEGEND

SAMPLE TYPE	GRAPHICAL SYMBOL	SAMPLE DESCRIPTION
AUGER		SAMPLE COLLECTED FROM AUGER CUTTINGS, NO FIELD MEASUREMENT OF SOIL STRENGTH. (DISTURBED)
CORE		ROCK CORE SAMPLE: TYPICALLY TAKEN WITH A DIAMOND-TIPPED CORE BARREL. TYPICALLY USED ONLY IN HIGHLY CONSOLIDATED BEDROCK.
GRAB		SOIL SAMPLE TAKEN WITH NO SPECIALIZED EQUIPMENT, SUCH AS FROM A STOCKPILE OR THE GROUND SURFACE. (DISTURBED)
CS		CALIFORNIA SAMPLER: 2-1/2 INCH I.D. SPLIT BARREL SAMPLER, LINED WITH 1-INCH HIGH BRASS RINGS. DRIVEN WITH SPT HAMMER. (RELATIVELY UNDISTURBED)
NSR		NO RECOVERY: THE SAMPLING ATTEMPT DID NOT RESULT IN RECOVERY OF ANY SIGNIFICANT SOIL OR ROCK MATERIAL.
SPT		STANDARD PENETRATION TEST: SAMPLER IS A 1.4 INCH INSIDE DIAMETER SPLIT BARREL, DRIVEN 18 INCHES WITH THE SPT HAMMER. (DISTURBED)
SH		SHELBY TUBE: TAKEN WITH A THIN WALL SAMPLE TUBE, PUSHED INTO THE SOIL AND THEN EXTRACTED. (UNDISTURBED)
VANE		VANE SHEAR TEST: SOIL STRENGTH OBTAINED USING A 4 BLADED SHEAR DEVICE. TYPICALLY USED IN SOFT CLAYS-NO SAMPLE RECOVERED.

COLUMN DESCRIPTIONS

DEPTH: Distance in feet below the ground surface.

SAMPLE: Sample Type as depicted above.

BLOW COUNT: Number of blows required to advance the sampler 12 inches using a 140 lb hammer with a 30-inch drop. 50/3" indicates penetration refusal (>50 blows) at 3 inches. WH indicates that the weight of the hammer was sufficient to push the sampler 6 inches or more.

POCKET PEN.: Approximate shear strength of a cohesive soil sample as measured by pocket penetrometer.

GRAPHIC LOG: Graphic Soil Symbol as depicted on the following page.

DRY DENSITY: Dry density of an undisturbed or relatively undisturbed sample in lbs/ft^3.

MOISTURE CONTENT: Moisture content of a soil sample, expressed as a percentage of the dry weight.

LIQUID LIMIT: The moisture content above which a soil behaves as a liquid.

PLASTIC LIMIT: The moisture content above which a soil behaves as a plastic.

PASSING #200 SIEVE: The percentage of the sample finer than the #200 standard sieve.

UNCONFINED SHEAR: The shear strength of a cohesive soil sample, as measured in the unconfined state.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-1

JOB NO.: 17G129
PROJECT: Proposed C/I Bldg
LOCATION: Ontario, California
DRILLING DATE: 4/5/17
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jason Hiskey
WATER DEPTH: Dry
CAVE DEPTH: 25 feet
READING TAKEN: At Completion

SURFACE ELEVATION: 679 feet MSL

FIELD RESULTS					DESCRIPTION	LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					ALLUVIUM: Brown Silty fine Sand, loose to medium dense-damp							
	X	11				103	4					
	X	20				102	4					
5	X	15				100	5					
					Light Gray fine to coarse Sand, trace fine Gravel, medium dense-dry to damp							
	X	23				115	2					
					Gray Brown fine Sand, trace medium Sand, medium dense-damp							
10	X	28				98	4					
					Brown Silty fine Sand, medium dense-damp							
15	X	15					6					
					Brown fine to medium Sand, trace Silt, trace Iron oxide staining, medium dense to dense-damp							
20	X	30					4					
					Light Brown fine Sand, trace Iron oxide staining, very dense-damp							
25	X	64					5					
					Gray Brown fine Sandy Clay, some Iron oxide staining, very stiff-very moist							
30	X	19	2.0				20					
					Boring Terminated at 30'							

TBL 17G129.GPJ SOCALGEO.GDT 5/18/17

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-2

JOB NO.: 17G129	DRILLING DATE: 4/5/17	WATER DEPTH: Dry
PROJECT: Proposed C/I Bldg	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 15 feet
LOCATION: Ontario, California	LOGGED BY: Jason Hiskey	READING TAKEN: At Completion

SURFACE ELEVATION: 676 feet MSL

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					6± inches Manure							
	X	20			FILL: Gray Brown Silty fine Sand, trace to little medium to coarse Sand, trace fine Gravel, medium dense-damp		3					
	X	16			FILL: Gray Brown Silty fine to medium Sand, trace coarse Sand, medium dense-very moist		15					
5												
	X	16			ALLUVIUM: Brown Silty fine Sand, medium dense-very moist		15					
	X	28			Light Gray fine to coarse Sand, trace fine Gravel, medium dense-dry		2					
10												
					Light Gray fine to medium Sand, little coarse Sand, trace fine to coarse Gravel, medium dense-dry							
	X	29					2					
15												
					Brown fine Sand, trace to little medium Sand, trace Silt, medium dense-dry to damp							
	X	28					3					
20												
					Boring Terminated at 20'							

TBL 17G129.GPJ SOCALGEO.GDT 5/18/17

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-3

JOB NO.: 17G129
PROJECT: Proposed C/I Bldg
LOCATION: Ontario, California

DRILLING DATE: 4/5/17
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jason Hiskey

WATER DEPTH: Dry
CAVE DEPTH: 12 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 675 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					5± inches Manure							
		20			FILL: Dark Gray Brown fine Sandy Silt, mottled, medium dense-damp to moist	105	11					
		21			ALLUVIUM: Brown Silty fine Sand, medium dense-damp	116	8					
5		20				104	5					
		27			Light Gray fine to coarse Sand, some fine to coarse Gravel, occasional Cobbles, medium dense-dry	114	1					
		28				91	2					
10					Brown Silty fine Sand, trace to little medium to coarse Sand, trace fine Gravel, medium dense-damp							
					Brown fine to medium Sand, trace fine Gravel, trace coarse Sand, medium dense-damp							
		14					4					
15												

Boring Terminated at 15'

TBL 17G129.GPJ SOCALGEO.GDT 5/18/17

TEST BORING LOG **PLATE B-3**

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-4

JOB NO.: 17G129
PROJECT: Proposed C/I Bldg
LOCATION: Ontario, California

DRILLING DATE: 4/5/17
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jason Hiskey

WATER DEPTH: Dry
CAVE DEPTH: 14 feet
READING TAKEN: At Completion

SURFACE ELEVATION: 672 feet MSL

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
	X	15			FILL: Dark Brown Silty fine Sand, some Organics, mottled, medium dense-damp to moist		10					
5	X	13			FILL: Dark Gray Brown Silty fine Sand with Clayey Silt nodules, slightly mottled, medium dense-moist		13					
	X	13			ALLUVIUM: Gray Brown Silty fine Sand, trace calcareous veining, medium dense-moist		12					
10	X	14			Gray Brown fine to medium Sand, trace coarse Sand, trace fine Gravel, medium dense-dry		2					
15	X	16			Brown fine to medium Sand, trace coarse Sand, little fine to coarse Gravel, trace Silt, medium dense-damp		4					
20	X	16			Orange Brown fine Sandy Silt, trace medium to coarse Sand, trace Iron oxide staining, medium dense-very moist		20					
					Boring Terminated at 20'							

TBL 17G129.GPJ SOCALGEO.GDT 5/18/17

BORING NO. B-5

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

JOB NO.: 17G129	DRILLING DATE: 4/5/17	WATER DEPTH: Dry
PROJECT: Proposed C/I Bldg	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 19 feet
LOCATION: Ontario, California	LOGGED BY: Jason Hiskey	READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 670 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					DISTURBED ALLUVIUM: Dark Brown Silty fine Sand, trace fine root fibers, some Organics, medium dense-damp to moist							
	X	12					11					
					ALLUVIUM: Gray Brown Silty fine Sand, medium dense-damp to moist							
	X	15					10					
5												
	X	15					9					
					Gray Brown fine to medium Sand, trace coarse Sand, trace to little fine Gravel, some coarse Gravel, medium dense-damp							
	X	24					4					
10												
					Brown fine to medium Sand, trace coarse Sand, trace fine to coarse Gravel, loose-damp							
	X	9					7					
15												
					Gray Brown fine Sandy Silt, little Clay, medium dense-very moist							
	X	14					20					
20												
	X	11					20					
25												
					Gray Brown Clayey Silt, stiff-very moist							
	X	12	2.0				33					
30												
					Boring Terminated at 30'							

TBL 17G129.GPJ SOCALGEO.GDT 5/18/17

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-6

JOB NO.: 17G129
PROJECT: Proposed C/I Bldg
LOCATION: Ontario, California

DRILLING DATE: 4/5/17
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jason Hiskey

WATER DEPTH:
CAVE DEPTH:
READING TAKEN: At Completion

SURFACE ELEVATION: 670 feet MSL

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					DISTURBED ALLUVIUM: Brown Silty fine Sand, trace fine root fibers, loose-damp							
	X	10				99	8					
					ALLUVIUM: Brown Silty fine Sand, loose-dry to moist							
	X	10				104	2					
5												
	X	8				104	12					
					Gray Brown fine to medium Sand, trace coarse Sand, trace fine Gravel, loose to medium dense-damp							
	X	15				102	7					
10												
	X	24				113	10					
15												
					Gray Brown Clayey Silt, very stiff-very moist							
	X	19	1.0				24					
20												
					Boring Terminated at 20'							

TBL 17G129.GPJ SOCALGEO.GDT 5/18/17

TEST BORING LOG

PLATE B-6

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-7

JOB NO.: 17G129
PROJECT: Proposed C/I Bldg
LOCATION: Ontario, California

DRILLING DATE: 4/5/17
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jason Hiskey

WATER DEPTH: Dry
CAVE DEPTH: 25 feet
READING TAKEN: At Completion

SURFACE ELEVATION: 668 feet MSL

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					DISTURBED ALLUVIUM: Brown Silty fine Sand, trace fine root fibers, loose-moist to very moist							
		8				94	16					
					ALLUVIUM: Brown Silty fine Sand, loose-damp							
		11				94	6					
5		10				98	7					
		15			@ 7 to 8 feet, medium dense	101	7					
					Gray Brown fine to medium Sand, trace fine Gravel, medium dense-damp							
		26				102	6					
10												
		20				96	6					
15												
		30			@ 18½ to 20 feet, medium dense to dense		7					
20												
					Gray Brown Silty fine Sand, Iron oxide staining, medium dense-very moist							
		24					23					
25												
					Gray Brown fine Sandy Silt, medium dense-very moist to wet							
		21					17					
30												
					Boring Terminated at 30'							

TBL 17G129.GPJ SOCALGEO.GDT 5/18/17

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-8

JOB NO.: 17G129
PROJECT: Proposed C/I Bldg
LOCATION: Ontario, California

DRILLING DATE: 4/5/17
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jason Hiskey

WATER DEPTH: Dry
CAVE DEPTH: 13 feet
READING TAKEN: At Completion

SURFACE ELEVATION: 665 feet MSL

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					DISTURBED ALLUVIUM: Brown Silty fine Sand, trace fine root fibers, very loose to loose-damp							
	X	2					8					
	X	5					10					
5					ALLUVIUM: Brown Silty fine Sand, very loose to loose-damp							
	X	2					7					
	■	9				99	8					
10												
					Gray Brown fine to medium Sand, loose to medium dense-damp							
	■	15				112	6					
15					Brown Silty fine to medium Sand, trace Clay, trace coarse Sand, loose to medium dense-damp							
					Gray Brown fine to coarse Sand, trace Silt, little fine to coarse Gravel, medium dense-damp							
	■	26				122	3					
20												

Boring Terminated at 20'

TBL 17G129.GPJ SOCALGEO.GDT 5/18/17

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-9

JOB NO.: 17G129
PROJECT: Proposed C/I Bldg
LOCATION: Ontario, California
DRILLING DATE: 4/5/17
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jason Hiskey
WATER DEPTH: Dry
CAVE DEPTH: 13 feet
READING TAKEN: At Completion

SURFACE ELEVATION: 665 feet MSL

DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					<u>DISTURBED ALLUVIUM:</u> Dark Brown Silty fine Sand, some Organics, trace fine root fibers, loose-very moist							
	X	7				86	24					
					<u>ALLUVIUM:</u> Gray Brown Silty fine Sand, loose-moist							
	X	9				88	15					
5	X	9				104	14					
					Gray Brown fine Sandy Silt, medium dense-damp to moist							
	X	18				108	11					
					Gray Brown Silty fine Sand to fine Sandy Silt, medium dense-very moist							
	X	18				98	19					
10												
					Gray Brown fine to medium Sand, trace coarse Sand, fine to coarse Gravel, medium dense-damp							
	X	18				101	9					
15												

Boring Terminated at 15'

TBL 17G129.GPJ SOCALGEO.GDT 5/18/17

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-10

JOB NO.: 17G129
PROJECT: Proposed C/I Bldg
LOCATION: Ontario, California

DRILLING DATE: 4/5/17
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jason Hiskey

WATER DEPTH: Dry
CAVE DEPTH: 3 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 666 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					DISTURBED ALLUVIUM: Brown Silty fine Sand, trace fine root fibers, loose-moist							
	X	8					12					
					ALLUVIUM: Brown Silty fine Sand, loose-damp							
	X	6					7					
5												
					Boring Terminated at 5'							

TBL 17G129.GPJ SOCALGEO.GDT 5/18/17

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-11

JOB NO.: 17G129	DRILLING DATE: 4/5/17	WATER DEPTH: Dry
PROJECT: Proposed C/I Bldg	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 3 feet
LOCATION: Ontario, California	LOGGED BY: Jason Hiskey	READING TAKEN: At Completion

SURFACE ELEVATION: 667 feet MSL

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					DISTURBED ALLUVIUM: Brown Silty fine Sand, trace fine root fibers, very loose to loose-moist							
	X	6					14					
					ALLUVIUM: Brown Silty fine Sand, very loose-damp							
	X	4					7					
5												
					Boring Terminated at 5'							

TBL 17G129.GPJ SOCALGEO.GDT 5/18/17

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-12

JOB NO.: 17G129
PROJECT: Proposed C/I Bldg
LOCATION: Ontario, California

DRILLING DATE: 4/5/17
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jason Hiskey

WATER DEPTH: Dry
CAVE DEPTH: 3 feet
READING TAKEN: At Completion

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION SURFACE ELEVATION: 675 feet MSL	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
					FILL: Brown Silty fine to medium Sand, trace coarse Sand, trace fine to coarse Gravel, medium dense-moist							
	X	16					16					
	X	15					11					
5					Boring Terminated at 5'							

TBL 17G129.GPJ SOCALGEO.GDT 5/18/17

TEST BORING LOG **PLATE B-12**

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

BORING NO. B-13

JOB NO.: 17G129
PROJECT: Proposed C/I Bldg
LOCATION: Ontario, California

DRILLING DATE: 4/5/17
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jason Hiskey

WATER DEPTH: Dry
CAVE DEPTH: 3 feet
READING TAKEN: At Completion

SURFACE ELEVATION: 675 feet MSL

FIELD RESULTS						LABORATORY RESULTS						
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	UNCONFINED SHEAR (TSF)	COMMENTS
	X	26			ALLUVIUM: Light Brown Silty fine Sand, trace medium Sand, medium dense-damp		4					
5	X	7			Light Brown fine Sand, trace to little Silt, loose-damp		4					
					Boring Terminated at 5'							

TBL 17G129.GPJ SOCALGEO.GDT 5/18/17

TEST BORING LOG **PLATE B-13**

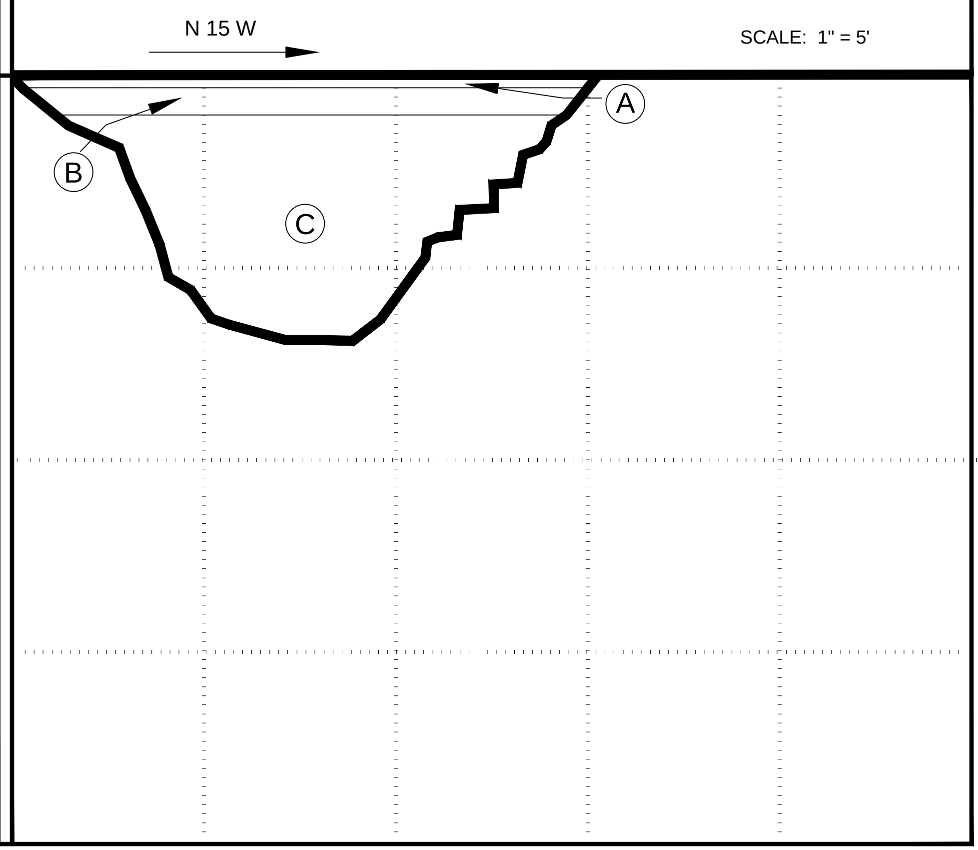
SOUTHERN CALIFORNIA GEOTECHNICAL

TRENCH NO. T-1

JOB NO.: 17G129-1	EQUIPMENT USED: Backhoe	WATER DEPTH: Dry
PROJECT: Proposed Commercial/Industrial Development	LOGGED BY: Anthony Luna	SEEPAGE DEPTH: Dry
LOCATION: Ontario, CA	ORIENTATION: N 15 W	READINGS TAKEN: At Completion
DATE: 4-4-2017	TOP OF TRENCH ELEVATION: 680 feet msl	

DEPTH	SAMPLE	DRY DENSITY (PCF)	MOISTURE (%)	EARTH MATERIALS DESCRIPTION
	b		15	A: MANURE: 3 inches thick
	b		13	B: FILL: Dark Brown Silty fine Sand, trace Clay, trace fine Gravel, some Organic content, trace Brick and Glass fragments, medium dense-moist
	b		11	
	b		8	
				C: ALLUVIUM: Light Brown Silty fine Sand, medium dense-damp
5				
	b		8	
				Trench Terminated @ 7 feet Bottom of Trench Elevation 673 feet msl
10				
15				

GRAPHIC REPRESENTATION



KEY TO SAMPLE TYPES:
B - BULK SAMPLE (DISTURBED)
R - RING SAMPLE 2-1/2" DIAMETER
(RELATIVELY UNDISTURBED)

TRENCH LOG

PLATE B-14

SOUTHERN CALIFORNIA GEOTECHNICAL

TRENCH NO. T-2

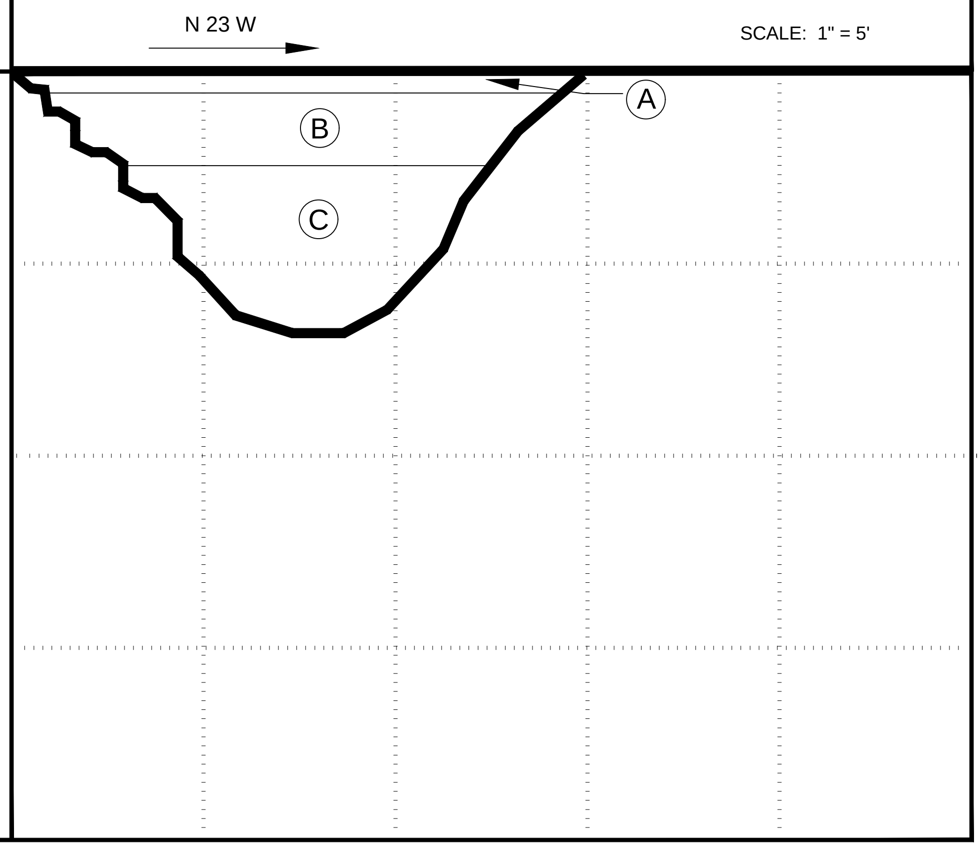
JOB NO.: 17G129-1
PROJECT: Proposed Commercial/Industrial Development
LOCATION: Ontario, CA
DATE: 4-4-2017

EQUIPMENT USED: Backhoe
LOGGED BY: Anthony Luna
ORIENTATION: N 23 W
TOP OF TRENCH ELEVATION: 675.5 feet msl

WATER DEPTH: Dry
SEEPAGE DEPTH: Dry
READINGS TAKEN: At Completion

DEPTH	SAMPLE	DRY DENSITY (PCF)	MOISTURE (%)	EARTH MATERIALS DESCRIPTION
	b		49	A: MANURE: 6 inches thick
	b		15	B: FILL: Brown Silty fine Sand, trace Clay, trace fine Gravel, some Organic content, trace Asphaltic concrete and Plastic fragments, medium dense-damp to moist
	b		9	
	b		10	
				C: ALLUVIUM: Light Brown Silty fine Sand, medium dense-damp to moist
	b		9	
5				
	b		6	
				Trench Terminated @ 7 feet Bottom of Trench Elevation 668.5 feet msl
10				
15				

GRAPHIC REPRESENTATION



KEY TO SAMPLE TYPES:
B - BULK SAMPLE (DISTURBED)
R - RING SAMPLE 2-1/2" DIAMETER
(RELATIVELY UNDISTURBED)

TRENCH LOG

PLATE B-15

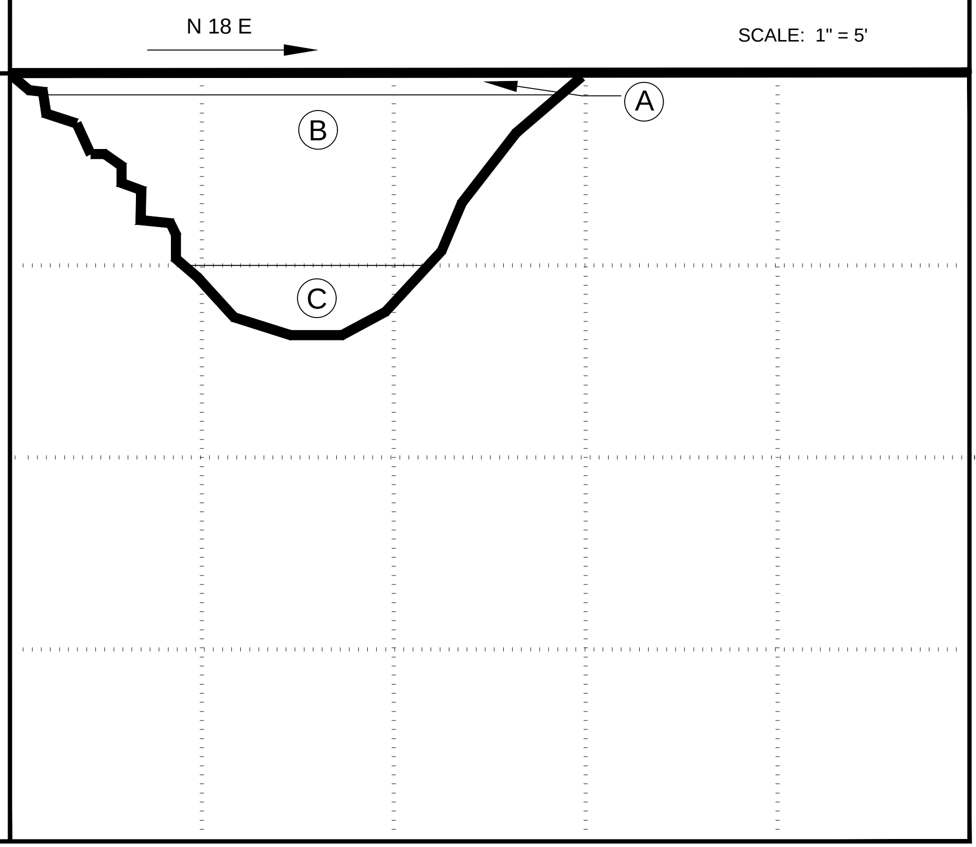
SOUTHERN CALIFORNIA GEOTECHNICAL

TRENCH NO.
T-3

JOB NO.: 17G129-1	EQUIPMENT USED: Backhoe	WATER DEPTH: Dry
PROJECT: Proposed Commercial/Industrial Development	LOGGED BY: Anthony Luna	SEEPAGE DEPTH: Dry
LOCATION: Ontario, CA	ORIENTATION: N 18 E	READINGS TAKEN: At Completion
DATE: 4-4-2017	TOP OF TRENCH ELEVATION: 673 feet msl	

DEPTH	SAMPLE	DRY DENSITY (PCF)	MOISTURE (%)	EARTH MATERIALS DESCRIPTION
	b		16	A: MANURE: 6 inches thick
	b		6	B: FILL: Brown Silty fine Sand, medium dense-damp to moist
	b		9	
	b		10	
5				
	b		2	C: ALLUVIUM: Light Gray fine to coarse Sand, little fine Gravel, medium dense-dry to damp
				Trench Terminated @ 7 feet Bottom of Trench Elevation 666 feet msl
10				
15				

GRAPHIC REPRESENTATION



KEY TO SAMPLE TYPES:
B - BULK SAMPLE (DISTURBED)
R - RING SAMPLE 2-1/2" DIAMETER
(RELATIVELY UNDISTURBED)

TRENCH LOG

PLATE B-16

SOUTHERN CALIFORNIA GEOTECHNICAL

TRENCH NO. T-4

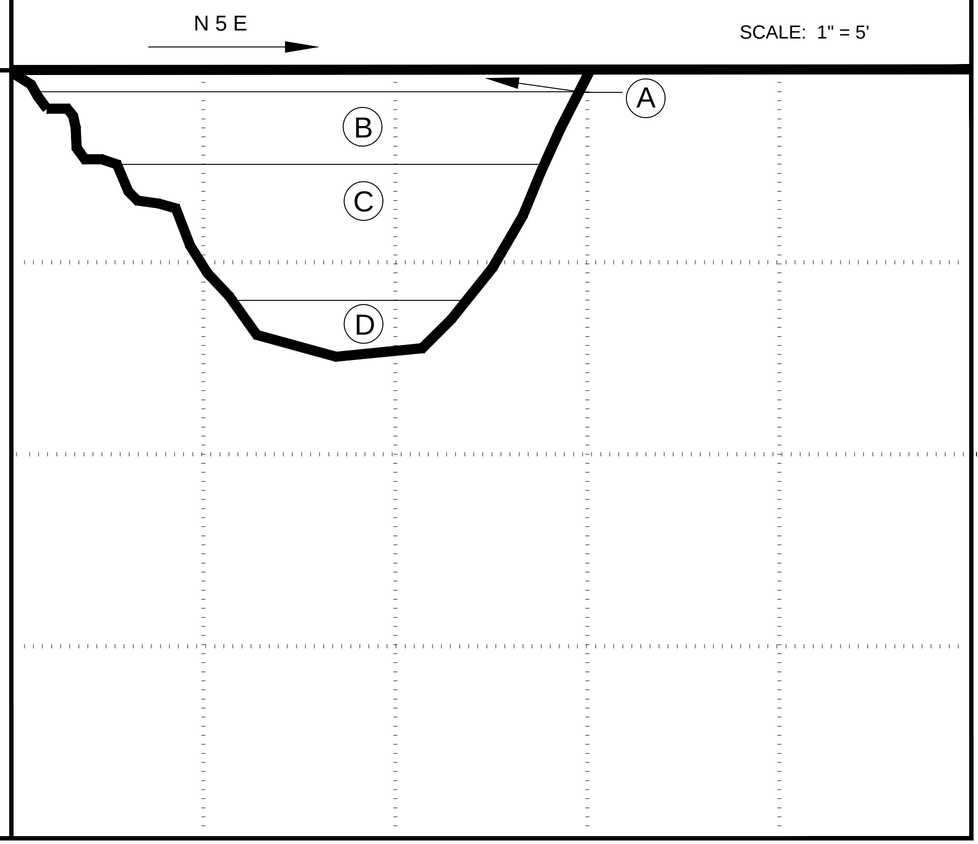
JOB NO.: 17G129-1
PROJECT: Proposed Commercial/Industrial Development
LOCATION: Ontario, CA
DATE: 4-4-2017

EQUIPMENT USED: Backhoe
LOGGED BY: Anthony Luna
ORIENTATION: N 5 E
TOP OF TRENCH ELEVATION: 671 feet msl

WATER DEPTH: Dry
SEEPAGE DEPTH: Dry
READINGS TAKEN: At Completion

DEPTH	SAMPLE	DRY DENSITY (PCF)	MOISTURE (%)	EARTH MATERIALS DESCRIPTION
	b		41	A: MANURE: 6 inches thick
	b		52	B: ALLUVIUM: Dark Brown to Black Silty fine Sand, trace Clay, some Organic content, abundant fine root fibers, medium dense-moist to very moist
	b		10	
	b		34	
				C: ALLUVIUM: Light Brown Silty fine Sand, medium dense-moist
	b		15	
5				
				D: ALLUVIUM: Light Gray fine Sand, trace Silt, medium dense-damp
	b		5	
				Trench Terminated @ 7.5 feet Bottom of Trench Elevation 663.5 feet msl
10				
15				

GRAPHIC REPRESENTATION



KEY TO SAMPLE TYPES:
B - BULK SAMPLE (DISTURBED)
R - RING SAMPLE 2-1/2" DIAMETER (RELATIVELY UNDISTURBED)

TRENCH LOG

PLATE B-17

SOUTHERN CALIFORNIA GEOTECHNICAL

TRENCH NO. T-5

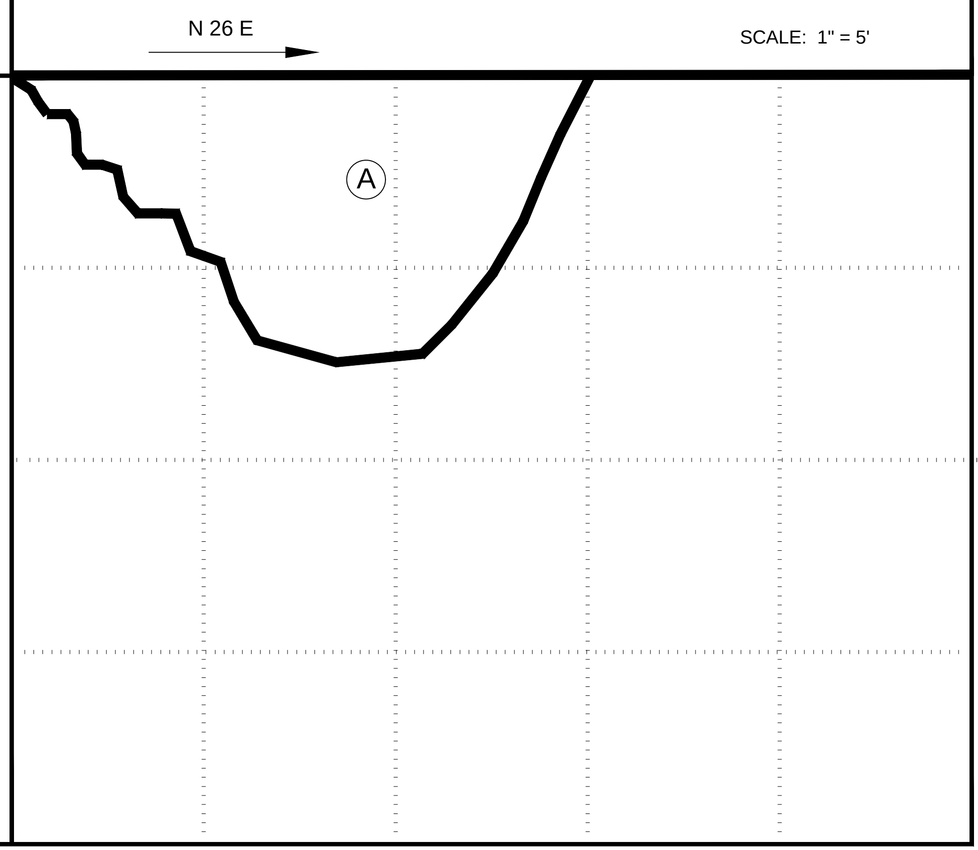
JOB NO.: 17G129-1
PROJECT: Proposed Commercial/Industrial Development
LOCATION: Ontario, CA
DATE: 4-4-2017

EQUIPMENT USED: Backhoe
LOGGED BY: Anthony Luna
ORIENTATION: N 26 E
TOP OF TRENCH ELEVATION: 667 feet msl

WATER DEPTH: Dry
SEEPAGE DEPTH: Dry
READINGS TAKEN: At Completion

DEPTH	SAMPLE	DRY DENSITY (PCF)	MOISTURE (%)	EARTH MATERIALS DESCRIPTION
	b		23	A: ALLUVIUM: Brown Silty fine Sand, trace medium Sand, trace fine root fibers, medium dense-moist to very moist
	b		18	
	b		10	
	b		14	
5				
	b		14	
				Trench Terminated @ 7 feet Bottom of Trench Elevation 660 feet msl
10				
15				

GRAPHIC REPRESENTATION



KEY TO SAMPLE TYPES:
B - BULK SAMPLE (DISTURBED)
R - RING SAMPLE 2-1/2" DIAMETER
(RELATIVELY UNDISTURBED)

TRENCH LOG

SOUTHERN CALIFORNIA GEOTECHNICAL

TRENCH NO. T-6

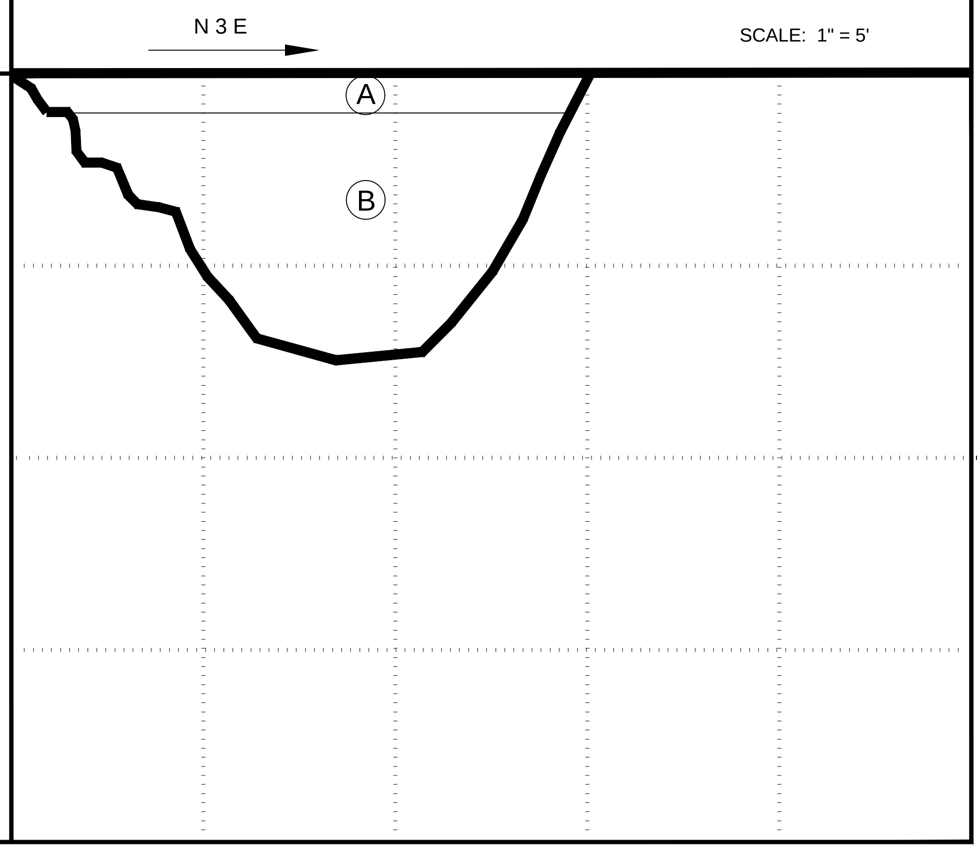
JOB NO.: 17G129-1
PROJECT: Proposed Commercial/Industrial Development
LOCATION: Ontario, CA
DATE: 4-4-2017

EQUIPMENT USED: Backhoe
LOGGED BY: Anthony Luna
ORIENTATION: N 3 E
TOP OF TRENCH ELEVATION: 665 feet msl

WATER DEPTH: Dry
SEEPAGE DEPTH: Dry
READINGS TAKEN: At Completion

DEPTH	SAMPLE	DRY DENSITY (PCF)	MOISTURE (%)	EARTH MATERIALS DESCRIPTION
	b		16	A: ALLUVIUM: Brown Silty fine Sand, some fine root fibers, medium dense-moist to very moist
	b		15	
	b		11	
	b		8	B: ALLUVIUM: Brown Silty fine Sand, some fine root fibers, medium dense-damp to moist
5				
	b		9	
				Trench Terminated @ 7.5 feet Bottom of Trench Elevation 657.5 feet msl
10				
15				

GRAPHIC REPRESENTATION



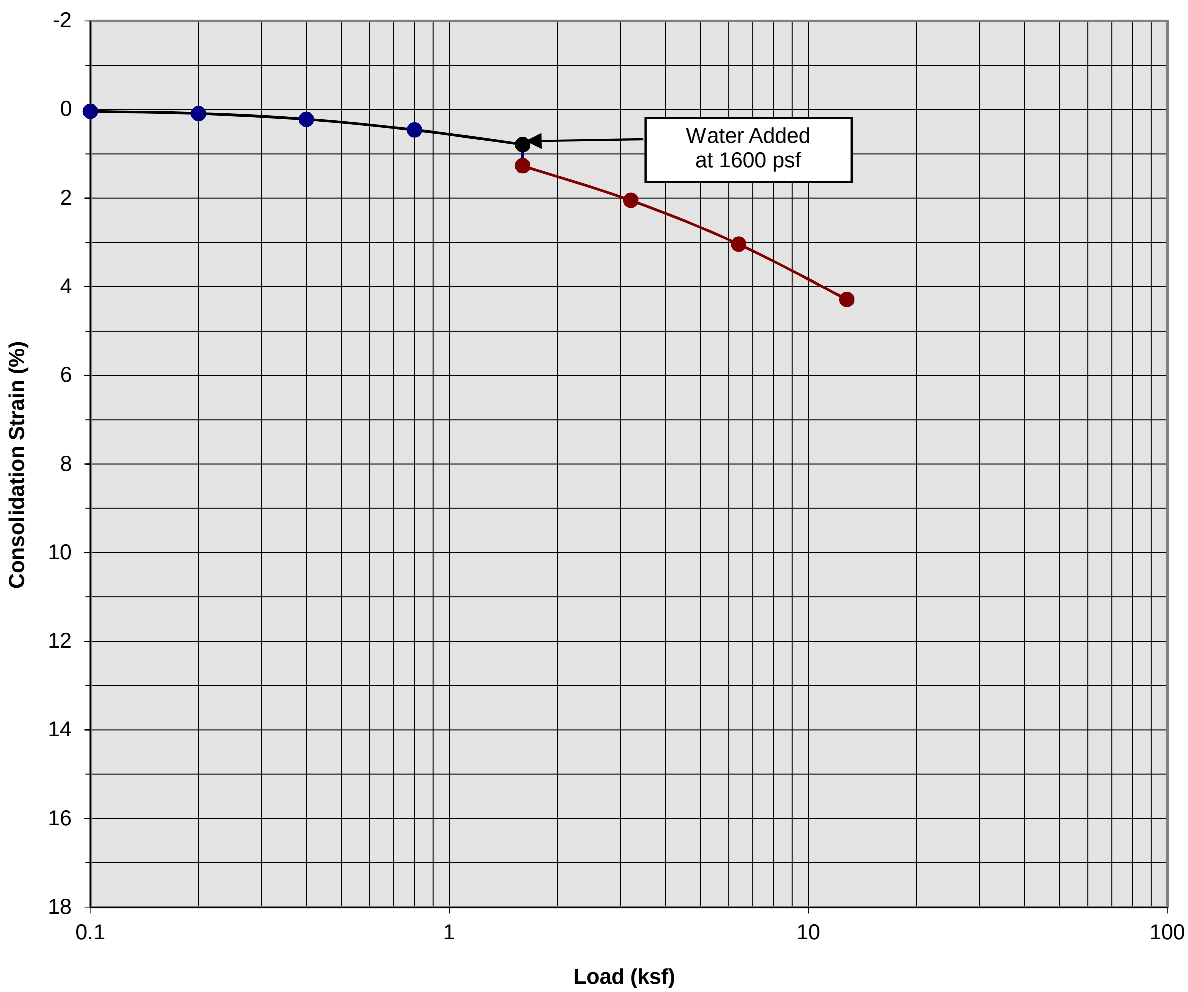
KEY TO SAMPLE TYPES:
B - BULK SAMPLE (DISTURBED)
R - RING SAMPLE 2-1/2" DIAMETER
(RELATIVELY UNDISTURBED)

TRENCH LOG

PLATE B-19

APPENDIX C

Consolidation/Collapse Test Results



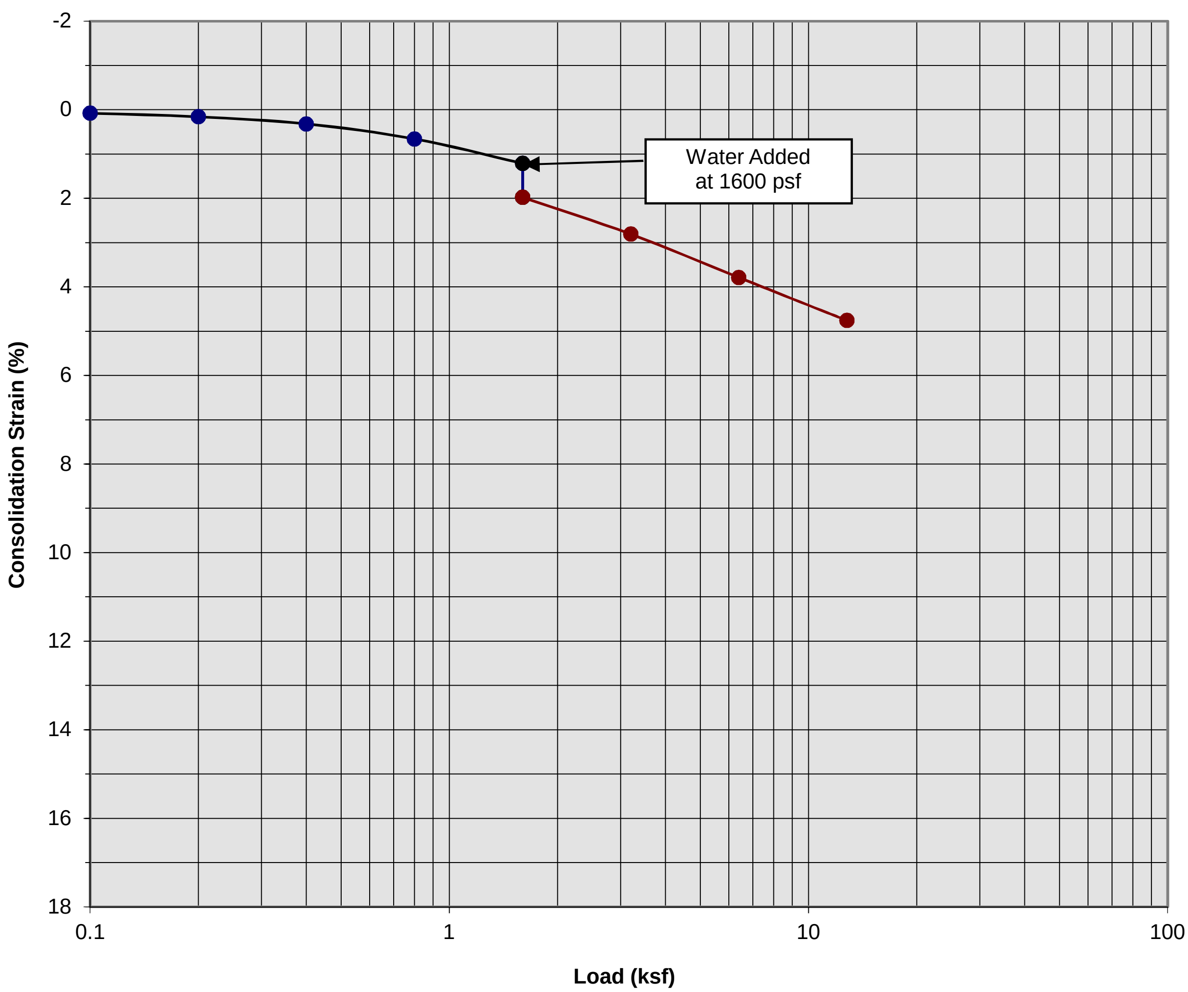
Classification: Brown Silty fine Sand

Boring Number:	B-1	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	19
Depth (ft)	1 to 2	Initial Dry Density (pcf)	102.7
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	102.3
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.48

Proposed Commercial/Industrial Development
Ontario, California
Project No. 17G129
PLATE C- 1

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results

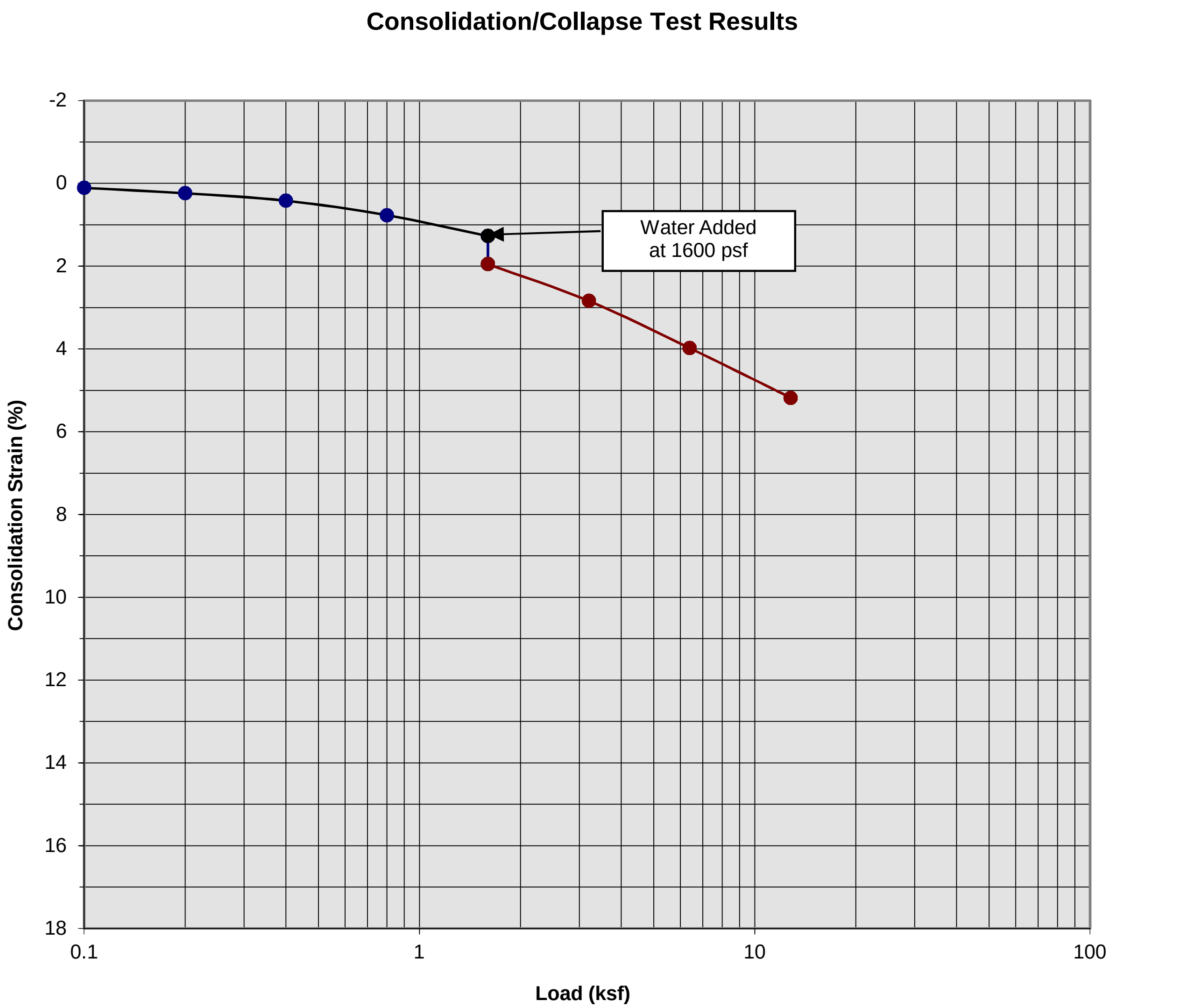


Classification: Brown Silty fine Sand

Boring Number:	B-1	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	20
Depth (ft)	3 to 4	Initial Dry Density (pcf)	102.0
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	104.7
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.77

Proposed Commercial/Industrial Development
Ontario, California
Project No. 17G129
PLATE C- 2

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

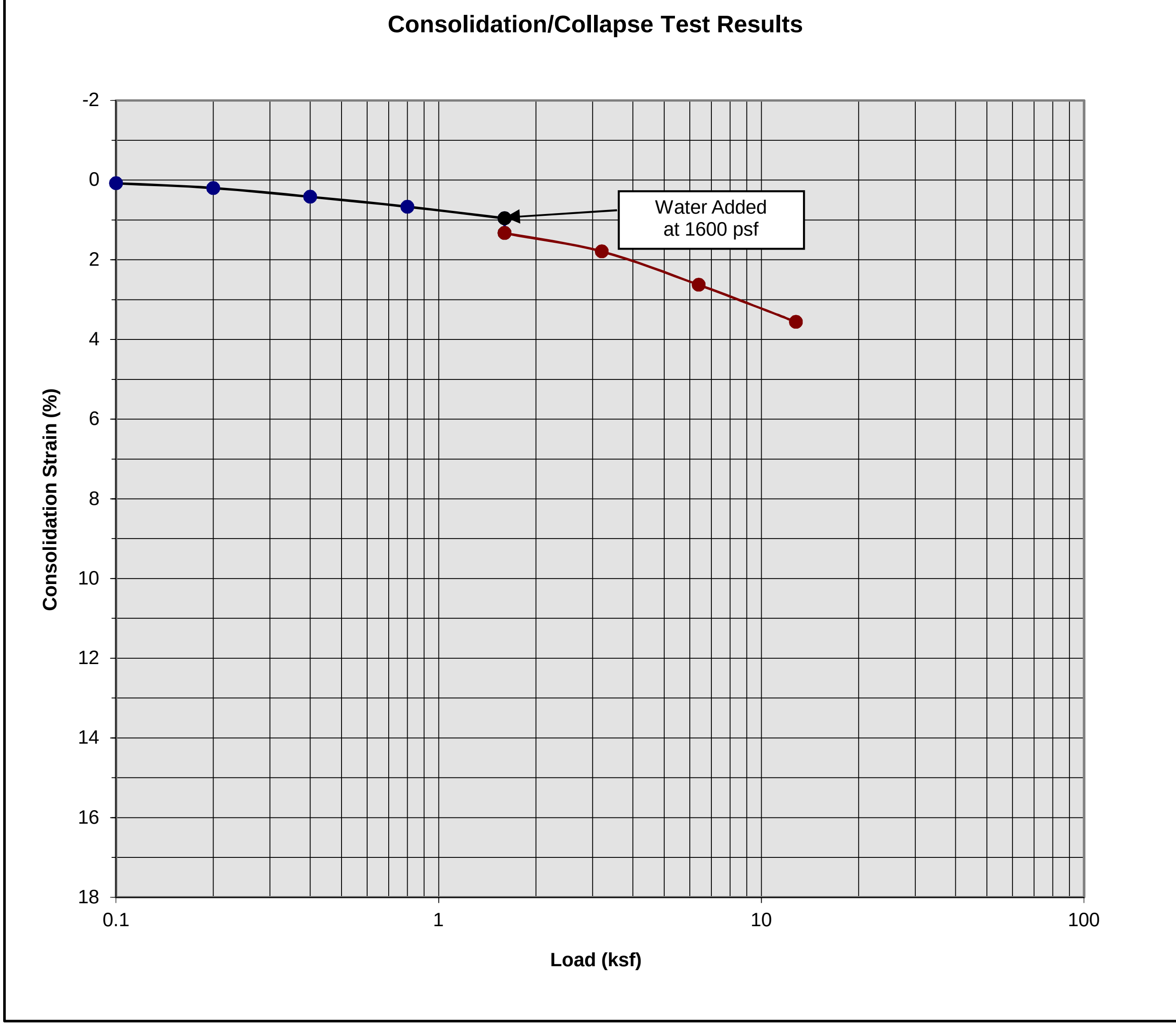


Classification: Brown Silty fine Sand

Boring Number:	B-1	Initial Moisture Content (%)	5
Sample Number:	---	Final Moisture Content (%)	20
Depth (ft)	5 to 6	Initial Dry Density (pcf)	99.5
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	104.0
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.68

Proposed Commercial/Industrial Development
Ontario, California
Project No. 17G129
PLATE C- 3

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

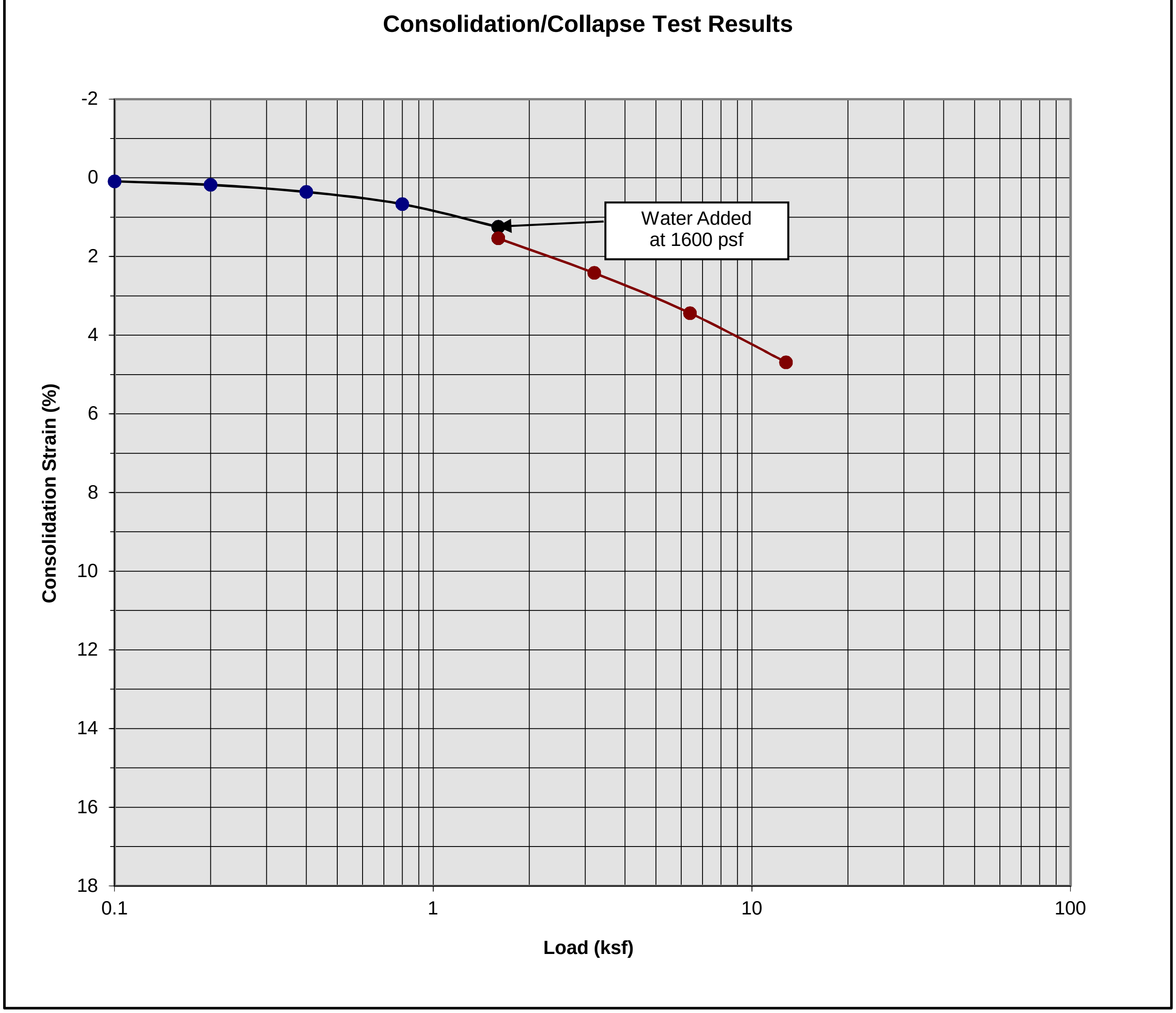


Classification: Light Gray fine to coarse Sand, trace fine Gravel

Boring Number:	B-1	Initial Moisture Content (%)	2
Sample Number:	---	Final Moisture Content (%)	14
Depth (ft)	7 to 8	Initial Dry Density (pcf)	115.4
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	120.2
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.37

Proposed Commercial/Industrial Development
Ontario, California
Project No. 17G129
PLATE C- 4

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



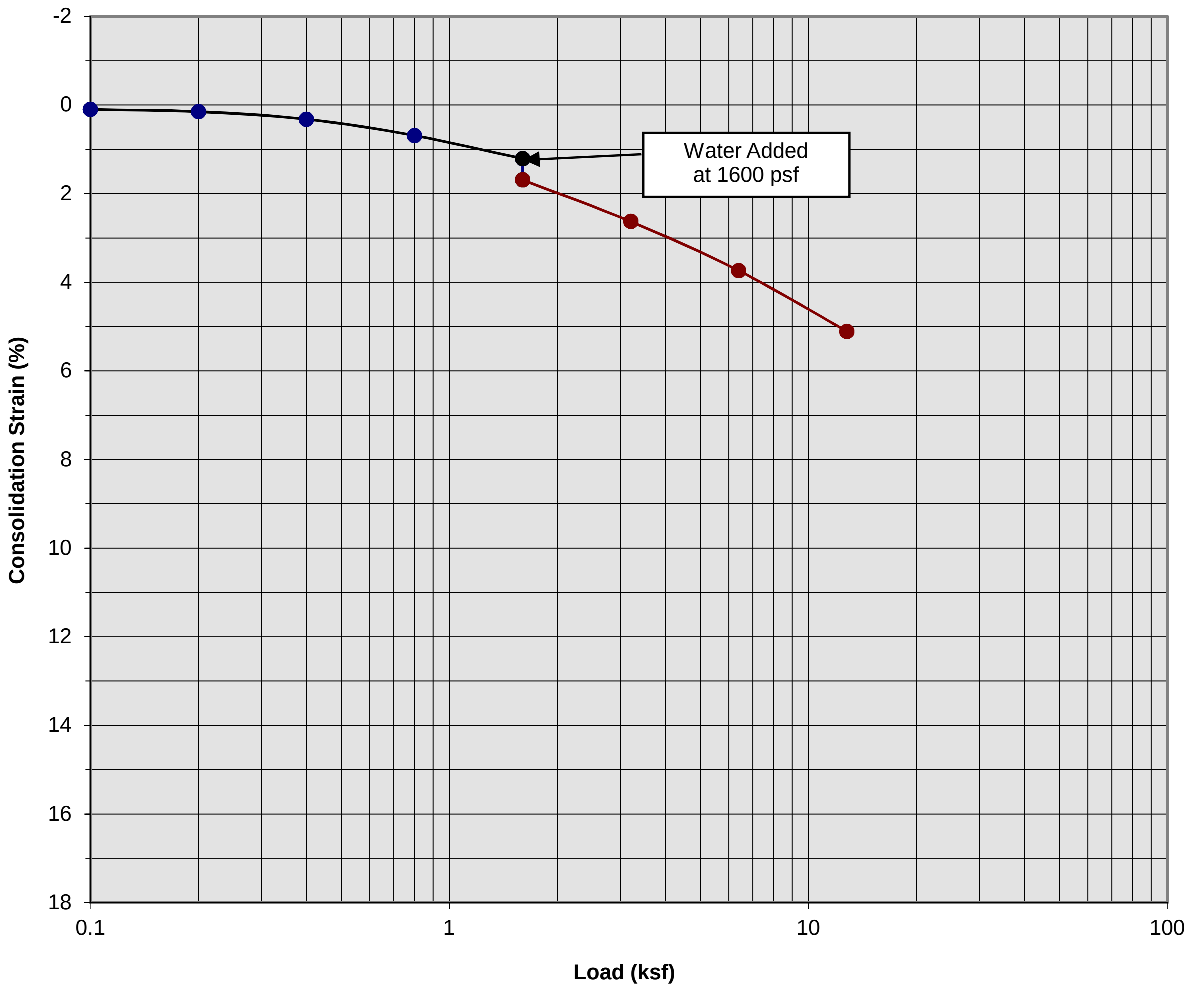
Classification: Brown Silty fine Sand

Boring Number:	B-6	Initial Moisture Content (%)	8
Sample Number:	---	Final Moisture Content (%)	23
Depth (ft)	1 to 2	Initial Dry Density (pcf)	99.7
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	104.3
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.29

Proposed Commercial/Industrial Development
Ontario, California
Project No. 17G129
PLATE C- 5

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results

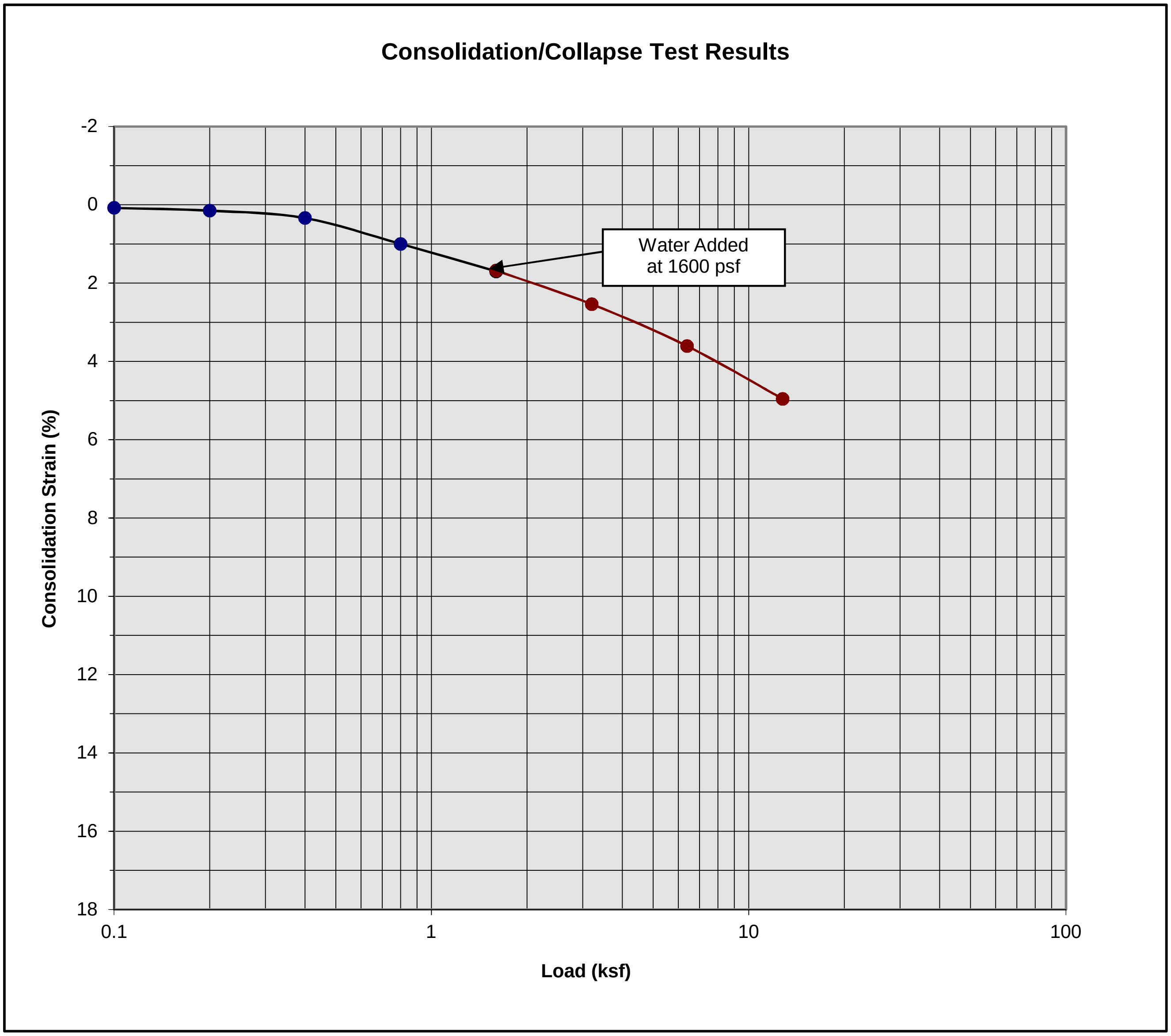


Classification: Brown Silty fine Sand

Boring Number:	B-6	Initial Moisture Content (%)	2
Sample Number:	---	Final Moisture Content (%)	22
Depth (ft)	3½ to 4½	Initial Dry Density (pcf)	103.7
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	110.3
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.48

Proposed Commercial/Industrial Development
Ontario, California
Project No. 17G129
PLATE C- 6

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

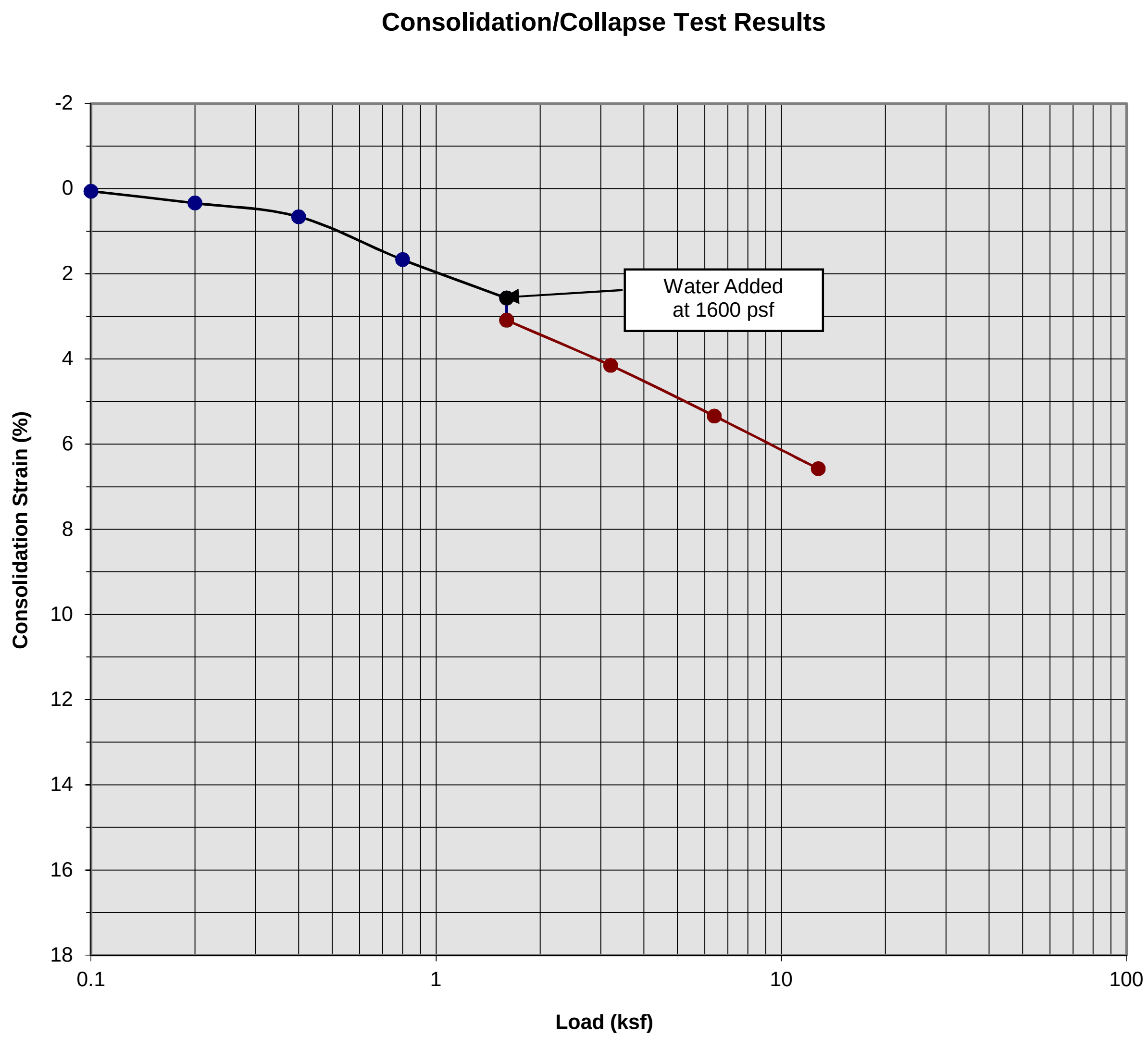


Classification: Brown Silty fine Sand

Boring Number:	B-6	Initial Moisture Content (%)	12
Sample Number:	---	Final Moisture Content (%)	21
Depth (ft)	6 to 7	Initial Dry Density (pcf)	103.7
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	109.1
Specimen Thickness (in)	1.0	Percent Collapse (%)	-0.02

Proposed Commercial/Industrial Development
Ontario, California
Project No. 17G129
PLATE C- 7

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



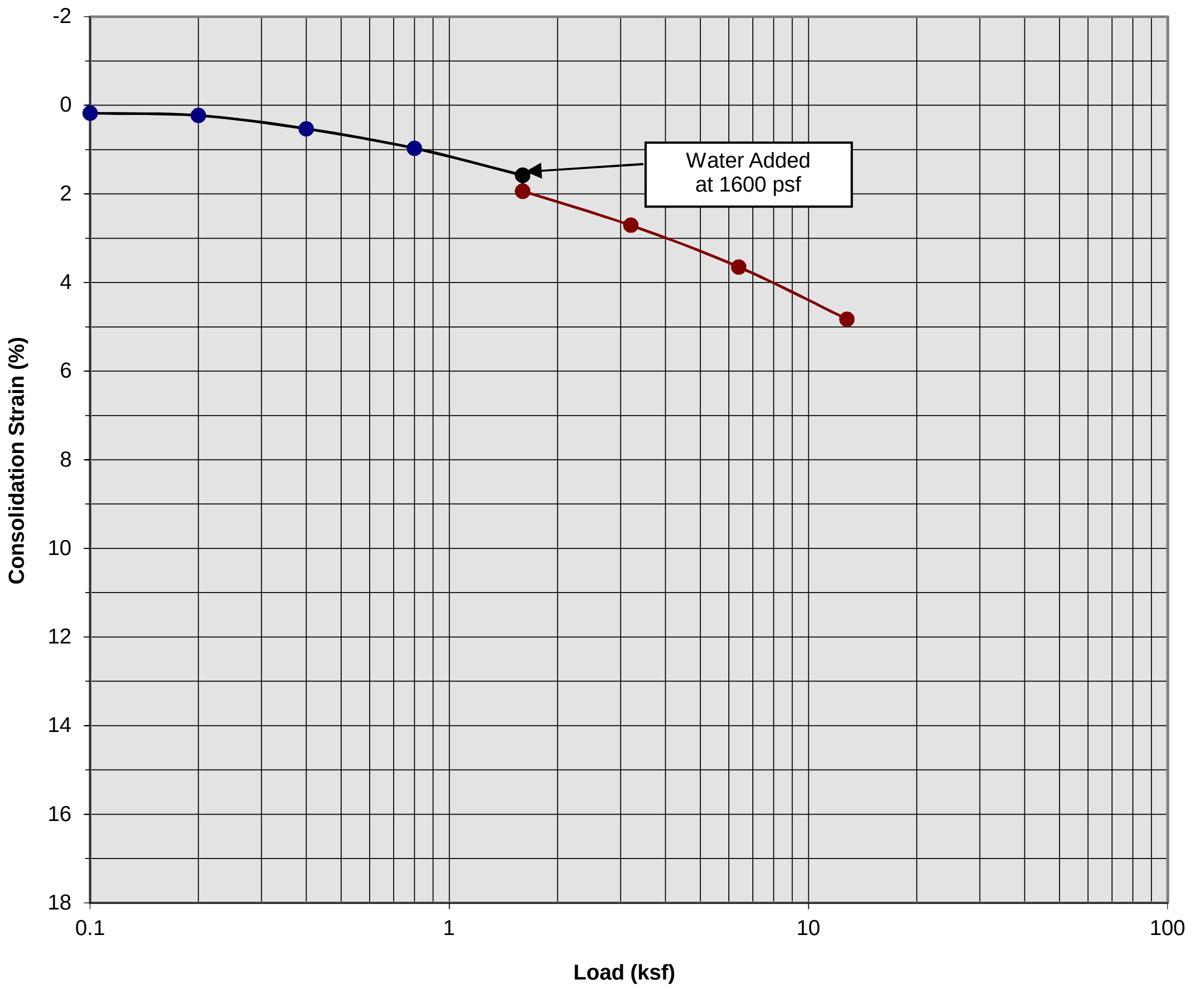
Classification: Gray Brown fine to medium Sand, trace coarse Sand, trace fine Gravel

Boring Number:	B-6	Initial Moisture Content (%)	7
Sample Number:	---	Final Moisture Content (%)	18
Depth (ft)	8½ to 9½	Initial Dry Density (pcf)	102.8
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	110.2
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.52

Proposed Commercial/Industrial Development
Ontario, California
Project No. 17G129
PLATE C- 8

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results

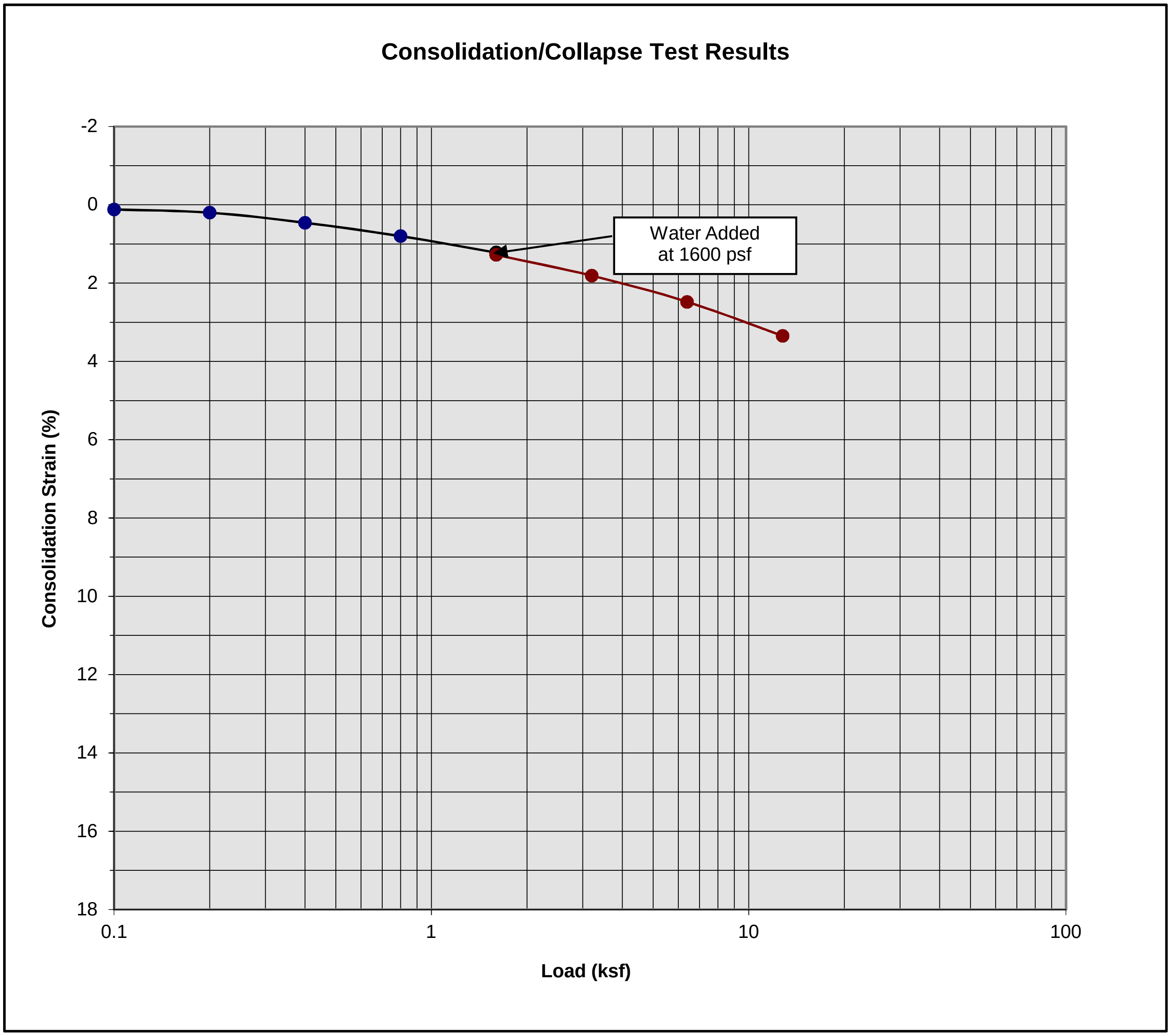


Classification: Gray Brown Silty fine Sand

Boring Number:	B-9	Initial Moisture Content (%)	11
Sample Number:	---	Final Moisture Content (%)	23
Depth (ft)	3 to 4	Initial Dry Density (pcf)	89.3
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	96.2
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.36

Proposed Commercial/Industrial Development
Ontario, California
Project No. 17G129
PLATE C- 9

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



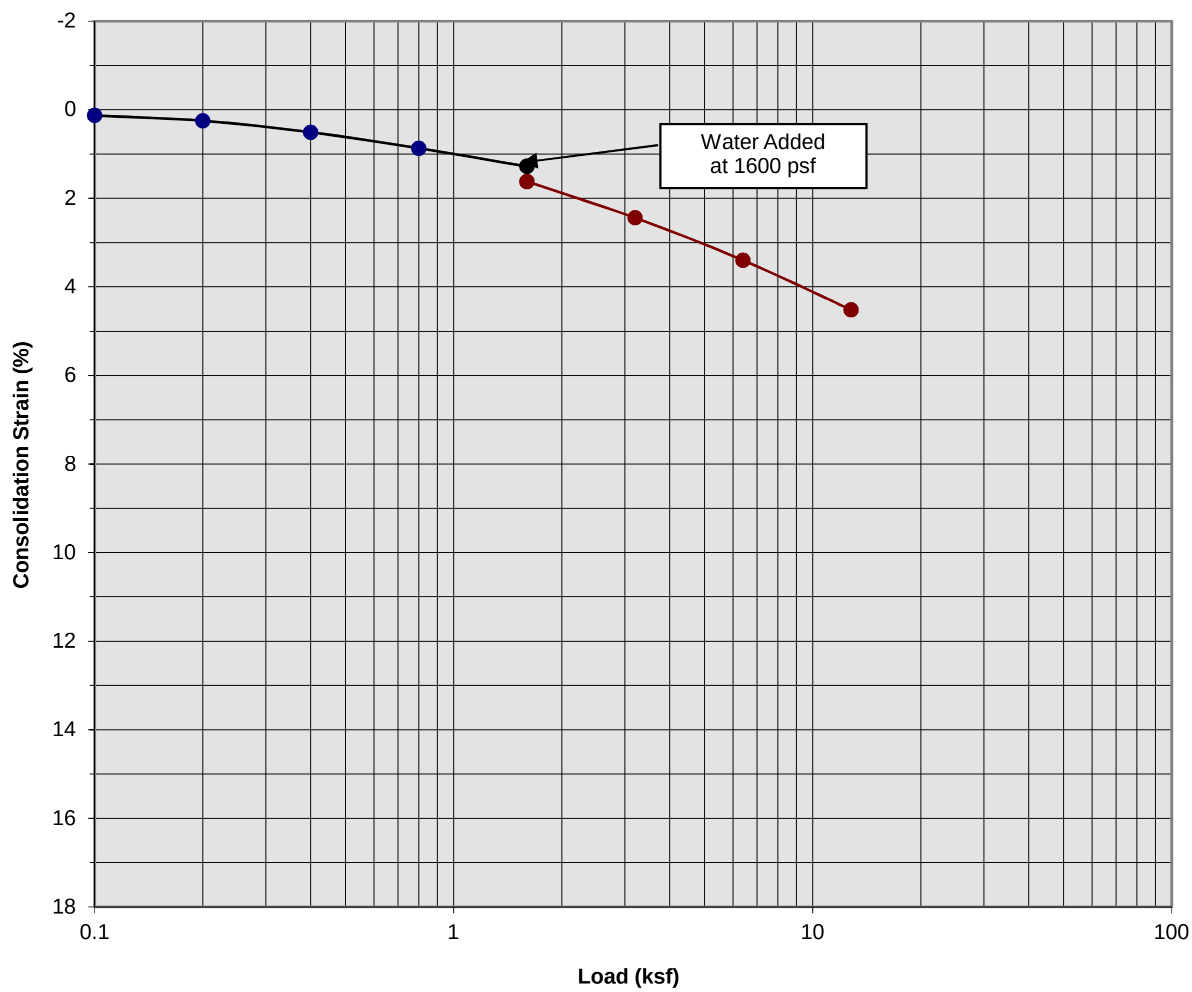
Classification: Gray Brown Silty fine Sand

Boring Number:	B-9	Initial Moisture Content (%)	14
Sample Number:	---	Final Moisture Content (%)	19
Depth (ft)	5 to 6	Initial Dry Density (pcf)	105.5
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	105.0
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.06

Proposed Commercial/Industrial Development
Ontario, California
Project No. 17G129
PLATE C- 10

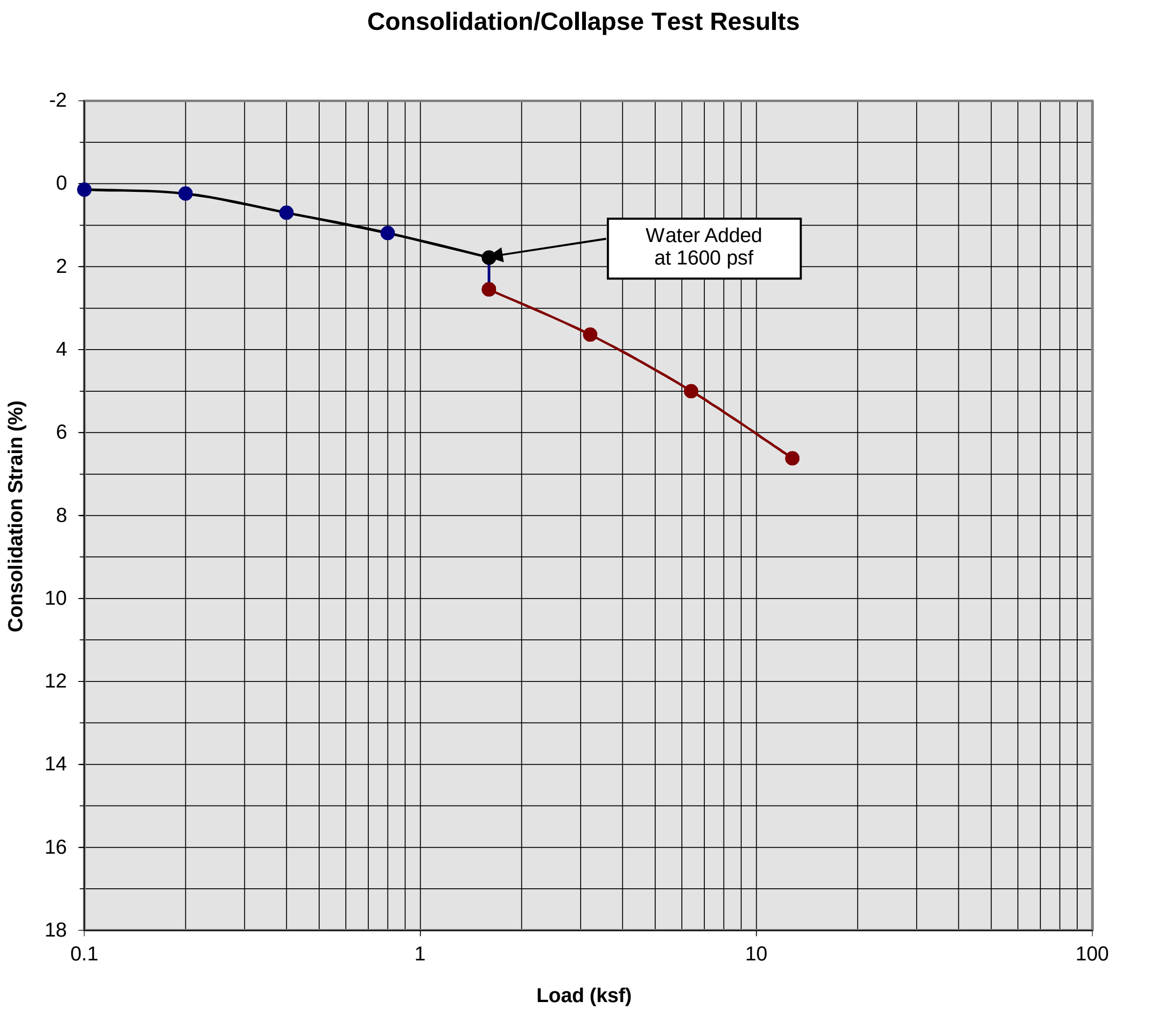
SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

Consolidation/Collapse Test Results



Classification: Gray Brown fine Sandy Silt

Boring Number:	B-9	Initial Moisture Content (%)	11
Sample Number:	---	Final Moisture Content (%)	17
Depth (ft)	7 to 8	Initial Dry Density (pcf)	109.4
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	113.1
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.34

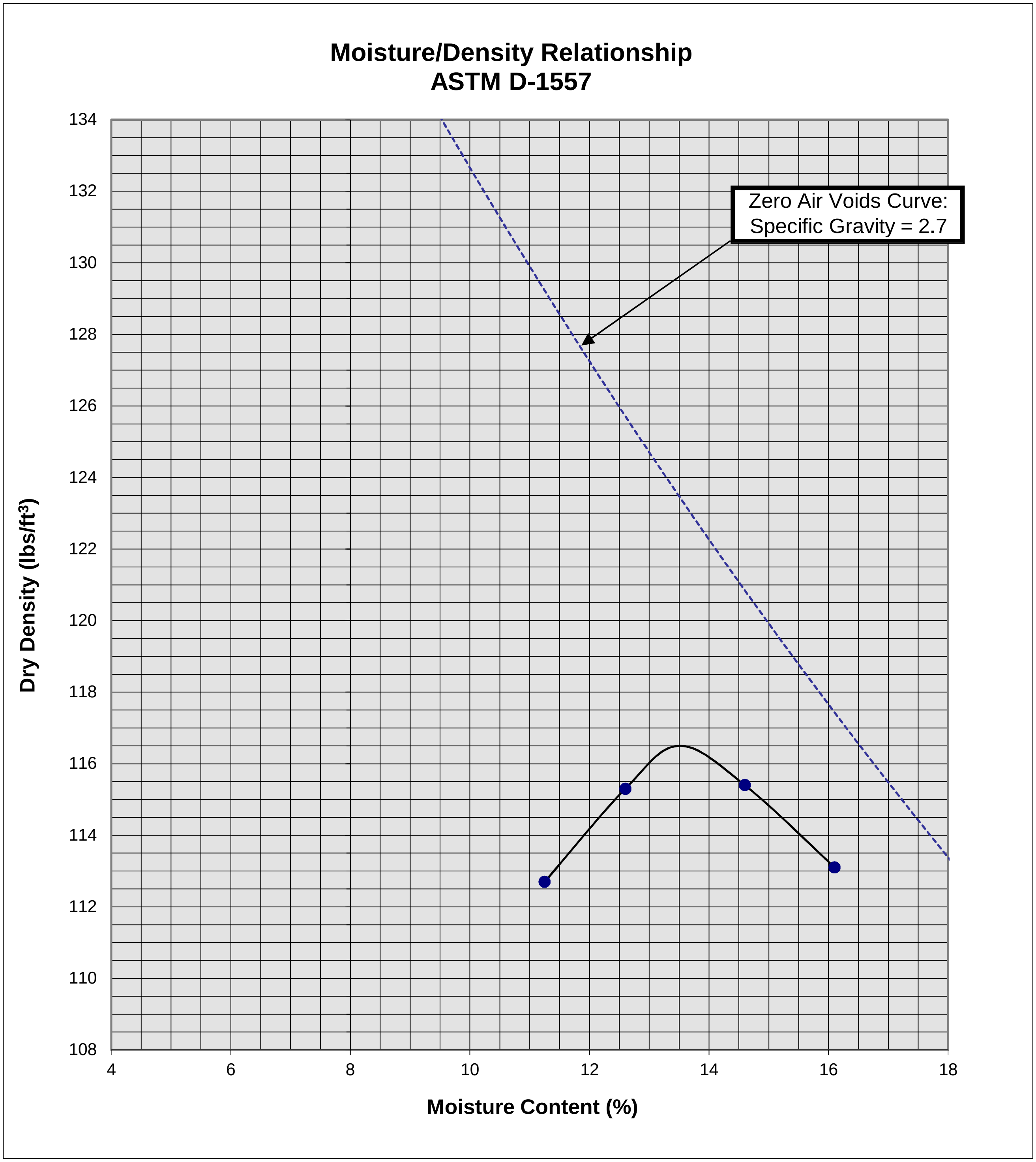


Classification: Gray Brown Silty fine Sand to fine Sandy Silt

Boring Number:	B-9	Initial Moisture Content (%)	19
Sample Number:	---	Final Moisture Content (%)	19
Depth (ft)	9 to 10	Initial Dry Density (pcf)	97.6
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	109.8
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.77

Proposed Commercial/Industrial Development
Ontario, California
Project No. 17G129
PLATE C- 12

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



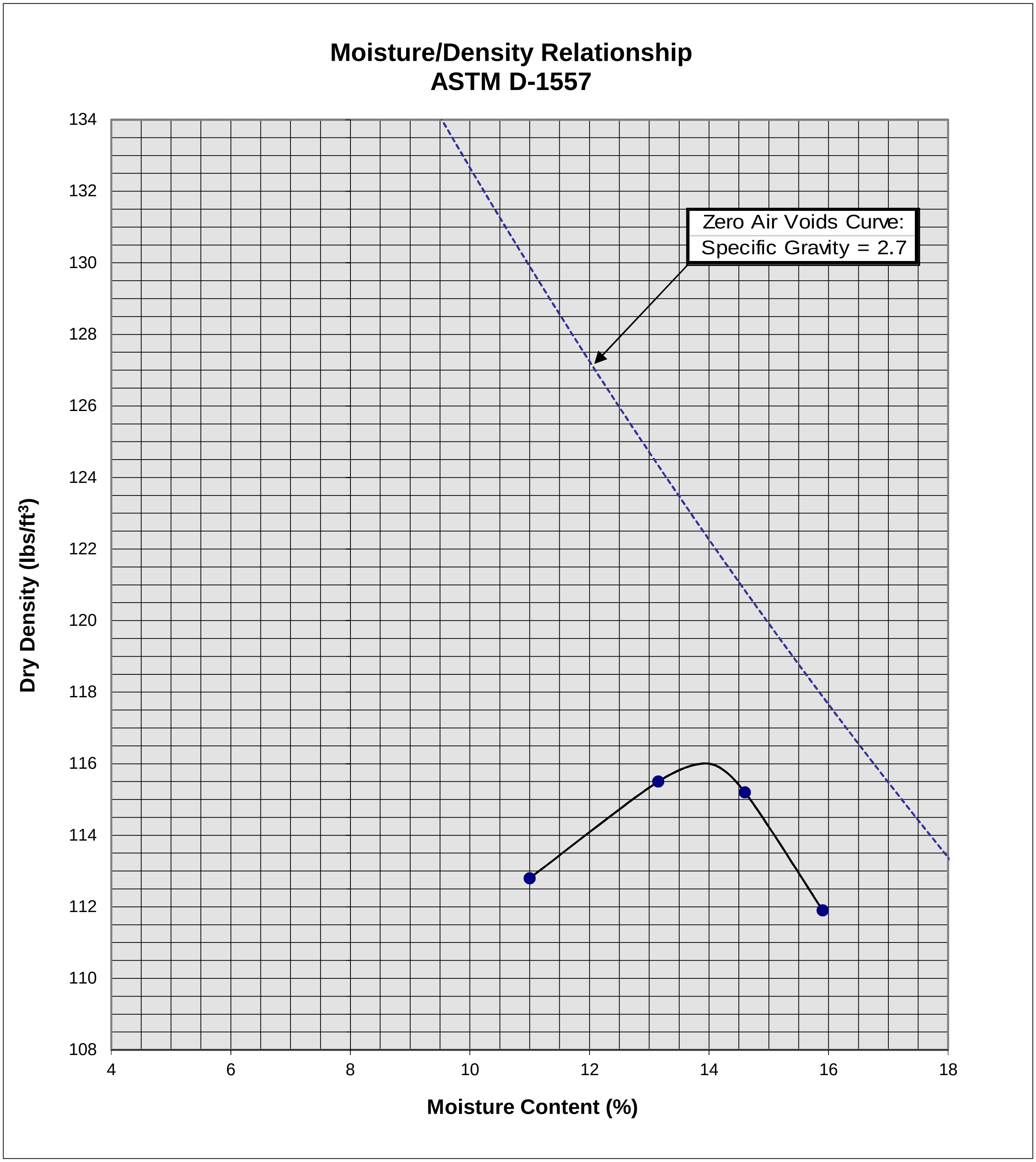
Soil ID Number	B-3 @ 0 to 5'
Optimum Moisture (%)	13.5
Maximum Dry Density (pcf)	116.5

Soil Classification	Brown Silty fine to medium Sand, trace fine Gravel

Proposed Commercial/Industrial Development
Ontario, California
Project No. 17G129

PLATE C-13

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation



Soil ID Number			B-9 @ 0 to 5'
Optimum Moisture (%)			14
Maximum Dry Density (pcf)			116
Soil Classification	Dark Brown Silty fine Sand		

Proposed Commercial/Industrial Development
Ontario, California
Project No. 17G129
PLATE C-14

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

APPENDIX D

GRADING GUIDE SPECIFICATIONS

These grading guide specifications are intended to provide typical procedures for grading operations. They are intended to supplement the recommendations contained in the geotechnical investigation report for this project. Should the recommendations in the geotechnical investigation report conflict with the grading guide specifications, the more site specific recommendations in the geotechnical investigation report will govern.

General

- The Earthwork Contractor is responsible for the satisfactory completion of all earthwork in accordance with the plans and geotechnical reports, and in accordance with city, county, and applicable building codes.

- The Geotechnical Engineer is the representative of the Owner/Builder for the purpose of implementing the report recommendations and guidelines. These duties are not intended to relieve the Earthwork Contractor of any responsibility to perform in a workman-like manner, nor is the Geotechnical Engineer to direct the grading equipment or personnel employed by the Contractor.

- The Earthwork Contractor is required to notify the Geotechnical Engineer of the anticipated work and schedule so that testing and inspections can be provided. If necessary, work may be stopped and redone if personnel have not been scheduled in advance.

- The Earthwork Contractor is required to have suitable and sufficient equipment on the job-site to process, moisture condition, mix and compact the amount of fill being placed to the approved compaction. In addition, suitable support equipment should be available to conform with recommendations and guidelines in this report.

- Canyon cleanouts, overexcavation areas, processed ground to receive fill, key excavations, subdrains and benches should be observed by the Geotechnical Engineer prior to placement of any fill. It is the Earthwork Contractor's responsibility to notify the Geotechnical Engineer of areas that are ready for inspection.

- Excavation, filling, and subgrade preparation should be performed in a manner and sequence that will provide drainage at all times and proper control of erosion. Precipitation, springs, and seepage water encountered shall be pumped or drained to provide a suitable working surface. The Geotechnical Engineer must be informed of springs or water seepage encountered during grading or foundation construction for possible revision to the recommended construction procedures and/or installation of subdrains.

Site Preparation

- The Earthwork Contractor is responsible for all clearing, grubbing, stripping and site preparation for the project in accordance with the recommendations of the Geotechnical Engineer.

- If any materials or areas are encountered by the Earthwork Contractor which are suspected of having toxic or environmentally sensitive contamination, the Geotechnical Engineer and Owner/Builder should be notified immediately.

- Major vegetation should be stripped and disposed of off-site. This includes trees, brush, heavy grasses and any materials considered unsuitable by the Geotechnical Engineer.

- Underground structures such as basements, cesspools or septic disposal systems, mining shafts, tunnels, wells and pipelines should be removed under the inspection of the Geotechnical Engineer and recommendations provided by the Geotechnical Engineer and/or city, county or state agencies. If such structures are known or found, the Geotechnical Engineer should be notified as soon as possible so that recommendations can be formulated.

- Any topsoil, slopewash, colluvium, alluvium and rock materials which are considered unsuitable by the Geotechnical Engineer should be removed prior to fill placement.

- Remaining voids created during site clearing caused by removal of trees, foundations basements, irrigation facilities, etc., should be excavated and filled with compacted fill.

- Subsequent to clearing and removals, areas to receive fill should be scarified to a depth of 10 to 12 inches, moisture conditioned and compacted

- The moisture condition of the processed ground should be at or slightly above the optimum moisture content as determined by the Geotechnical Engineer. Depending upon field conditions, this may require air drying or watering together with mixing and/or discing.

Compacted Fills

- Soil materials imported to or excavated on the property may be utilized in the fill, provided each material has been determined to be suitable in the opinion of the Geotechnical Engineer. Unless otherwise approved by the Geotechnical Engineer, all fill materials shall be free of deleterious, organic, or frozen matter, shall contain no chemicals that may result in the material being classified as "contaminated," and shall be very low to non-expansive with a maximum expansion index (EI) of 50. The top 12 inches of the compacted fill should have a maximum particle size of 3 inches, and all underlying compacted fill material a maximum 6-inch particle size, except as noted below.

- All soils should be evaluated and tested by the Geotechnical Engineer. Materials with high expansion potential, low strength, poor gradation or containing organic materials may require removal from the site or selective placement and/or mixing to the satisfaction of the Geotechnical Engineer.

- Rock fragments or rocks less than 6 inches in their largest dimensions, or as otherwise determined by the Geotechnical Engineer, may be used in compacted fill, provided the distribution and placement is satisfactory in the opinion of the Geotechnical Engineer.

- Rock fragments or rocks greater than 12 inches should be taken off-site or placed in accordance with recommendations and in areas designated as suitable by the Geotechnical Engineer. These materials should be placed in accordance with Plate D-8 of these Grading Guide Specifications and in accordance with the following recommendations:

  - Rocks 12 inches or more in diameter should be placed in rows at least 15 feet apart, 15 feet from the edge of the fill, and 10 feet or more below subgrade. Spaces should be left between each rock fragment to provide for placement and compaction of soil around the fragments.

  - Fill materials consisting of soil meeting the minimum moisture content requirements and free of oversize material should be placed between and over the rows of rock or concrete. Ample water and compactive effort should be applied to the fill materials as they are placed in order that all of the voids between each of the fragments are filled and compacted to the specified density.

- Subsequent rows of rocks should be placed such that they are not directly above a row placed in the previous lift of fill. A minimum 5-foot offset between rows is recommended.

- To facilitate future trenching, oversized material should not be placed within the range of foundation excavations, future utilities or other underground construction unless specifically approved by the soil engineer and the developer/owner representative.

- Fill materials approved by the Geotechnical Engineer should be placed in areas previously prepared to receive fill and in evenly placed, near horizontal layers at about 6 to 8 inches in loose thickness, or as otherwise determined by the Geotechnical Engineer for the project.

- Each layer should be moisture conditioned to optimum moisture content, or slightly above, as directed by the Geotechnical Engineer. After proper mixing and/or drying, to evenly distribute the moisture, the layers should be compacted to at least 90 percent of the maximum dry density in compliance with ASTM D-1557-78 unless otherwise indicated.

- Density and moisture content testing should be performed by the Geotechnical Engineer at random intervals and locations as determined by the Geotechnical Engineer. These tests are intended as an aid to the Earthwork Contractor, so he can evaluate his workmanship, equipment effectiveness and site conditions. The Earthwork Contractor is responsible for compaction as required by the Geotechnical Report(s) and governmental agencies.

- Fill areas unused for a period of time may require moisture conditioning, processing and recompaction prior to the start of additional filling. The Earthwork Contractor should notify the Geotechnical Engineer of his intent so that an evaluation can be made.

- Fill placed on ground sloping at a 5-to-1 inclination (horizontal-to-vertical) or steeper should be benched into bedrock or other suitable materials, as directed by the Geotechnical Engineer. Typical details of benching are illustrated on Plates D-2, D-4, and D-5.

- Cut/fill transition lots should have the cut portion overexcavated to a depth of at least 3 feet and rebuilt with fill (see Plate D-1), as determined by the Geotechnical Engineer.

- All cut lots should be inspected by the Geotechnical Engineer for fracturing and other bedrock conditions. If necessary, the pads should be overexcavated to a depth of 3 feet and rebuilt with a uniform, more cohesive soil type to impede moisture penetration.

- Cut portions of pad areas above buttresses or stabilizations should be overexcavated to a depth of 3 feet and rebuilt with uniform, more cohesive compacted fill to impede moisture penetration.

- Non-structural fill adjacent to structural fill should typically be placed in unison to provide lateral support. Backfill along walls must be placed and compacted with care to ensure that excessive unbalanced lateral pressures do not develop. The type of fill material placed adjacent to below grade walls must be properly tested and approved by the Geotechnical Engineer with consideration of the lateral earth pressure used in the design.

Foundations

- The foundation influence zone is defined as extending one foot horizontally from the outside edge of a footing, and proceeding downward at a ½ horizontal to 1 vertical (0.5:1) inclination.

- Where overexcavation beneath a footing subgrade is necessary, it should be conducted so as to encompass the entire foundation influence zone, as described above.

- Compacted fill adjacent to exterior footings should extend at least 12 inches above foundation bearing grade. Compacted fill within the interior of structures should extend to the floor subgrade elevation.

Fill Slopes

- The placement and compaction of fill described above applies to all fill slopes. Slope compaction should be accomplished by overfilling the slope, adequately compacting the fill in even layers, including the overfilled zone and cutting the slope back to expose the compacted core

- Slope compaction may also be achieved by backrolling the slope adequately every 2 to 4 vertical feet during the filling process as well as requiring the earth moving and compaction equipment to work close to the top of the slope. Upon completion of slope construction, the slope face should be compacted with a sheepsfoot connected to a sideboom and then grid rolled. This method of slope compaction should only be used if approved by the Geotechnical Engineer.

- Sandy soils lacking in adequate cohesion may be unstable for a finished slope condition and therefore should not be placed within 15 horizontal feet of the slope face.

- All fill slopes should be keyed into bedrock or other suitable material. Fill keys should be at least 15 feet wide and inclined at 2 percent into the slope. For slopes higher than 30 feet, the fill key width should be equal to one-half the height of the slope (see Plate D-5).

- All fill keys should be cleared of loose slough material prior to geotechnical inspection and should be approved by the Geotechnical Engineer and governmental agencies prior to filling.

- The cut portion of fill over cut slopes should be made first and inspected by the Geotechnical Engineer for possible stabilization requirements. The fill portion should be adequately keyed through all surficial soils and into bedrock or suitable material. Soils should be removed from the transition zone between the cut and fill portions (see Plate D-2).

Cut Slopes

- All cut slopes should be inspected by the Geotechnical Engineer to determine the need for stabilization. The Earthwork Contractor should notify the Geotechnical Engineer when slope cutting is in progress at intervals of 10 vertical feet. Failure to notify may result in a delay in recommendations.

- Cut slopes exposing loose, cohesionless sands should be reported to the Geotechnical Engineer for possible stabilization recommendations.

- All stabilization excavations should be cleared of loose slough material prior to geotechnical inspection. Stakes should be provided by the Civil Engineer to verify the location and dimensions of the key. A typical stabilization fill detail is shown on Plate D-5.

- Stabilization key excavations should be provided with subdrains. Typical subdrain details are shown on Plates D-6.

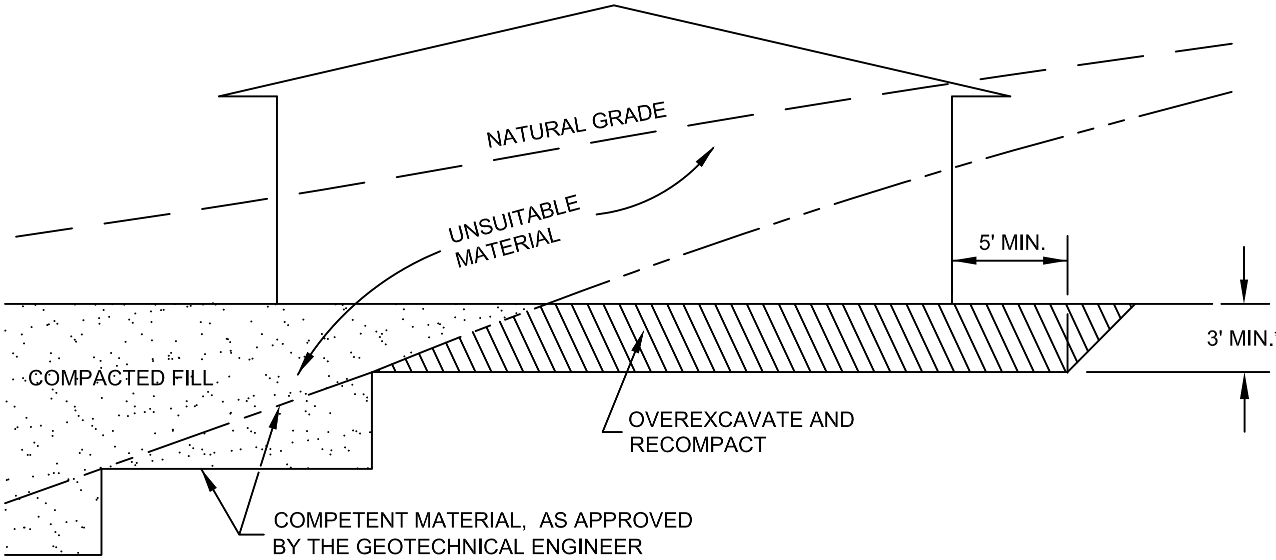
Subdrains

- Subdrains may be required in canyons and swales where fill placement is proposed. Typical subdrain details for canyons are shown on Plate D-3. Subdrains should be installed after approval of removals and before filling, as determined by the Soils Engineer.

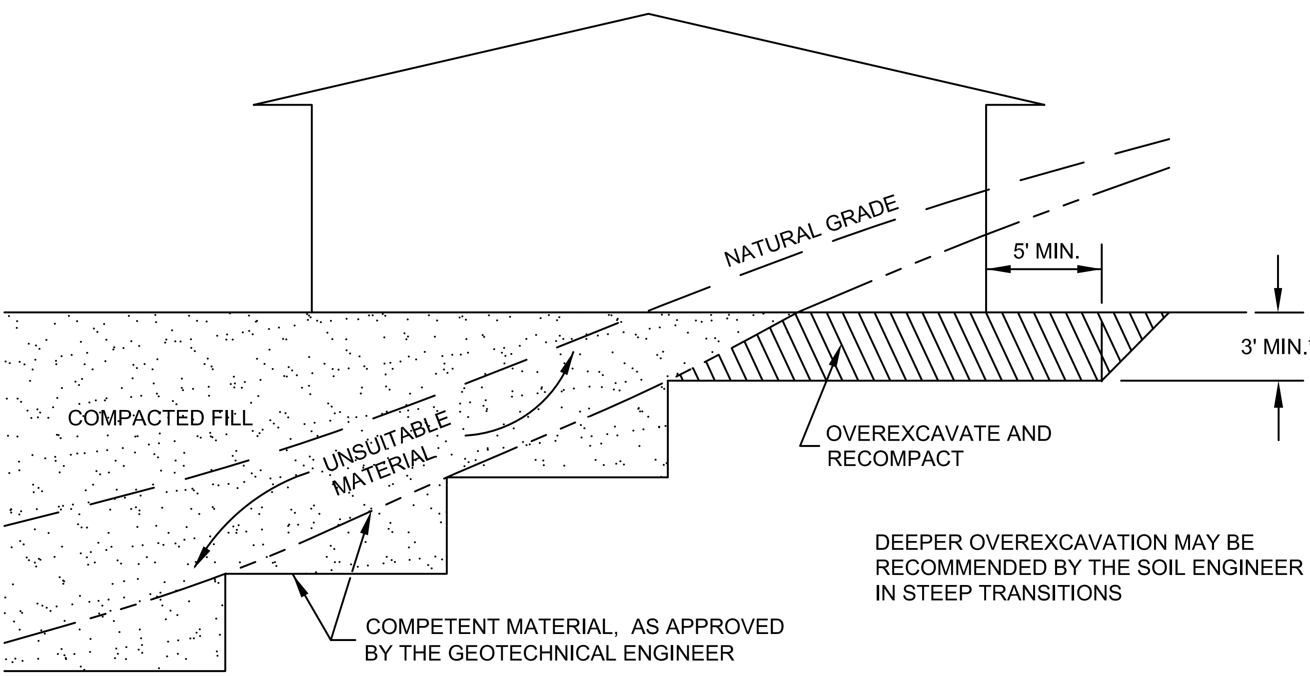
- Plastic pipe may be used for subdrains provided it is Schedule 40 or SDR 35 or equivalent. Pipe should be protected against breakage, typically by placement in a square-cut (backhoe) trench or as recommended by the manufacturer.

- Filter material for subdrains should conform to CALTRANS Specification 68-1.025 or as approved by the Geotechnical Engineer for the specific site conditions. Clean ¾-inch crushed rock may be used provided it is wrapped in an acceptable filter cloth and approved by the Geotechnical Engineer. Pipe diameters should be 6 inches for runs up to 500 feet and 8 inches for the downstream continuations of longer runs. Four-inch diameter pipe may be used in buttress and stabilization fills.

CUT LOT



CUT/FILL LOT (TRANSITION)



DEEPER OVEREXCAVATION MAY BE RECOMMENDED BY THE SOIL ENGINEER IN STEEP TRANSITIONS

*SEE TEXT OF REPORT FOR SPECIFIC RECOMMENDATION.
ACTUAL DEPTH OF OVEREXCAVATION MAY BE GREATER.

TRANSITION LOT DETAIL

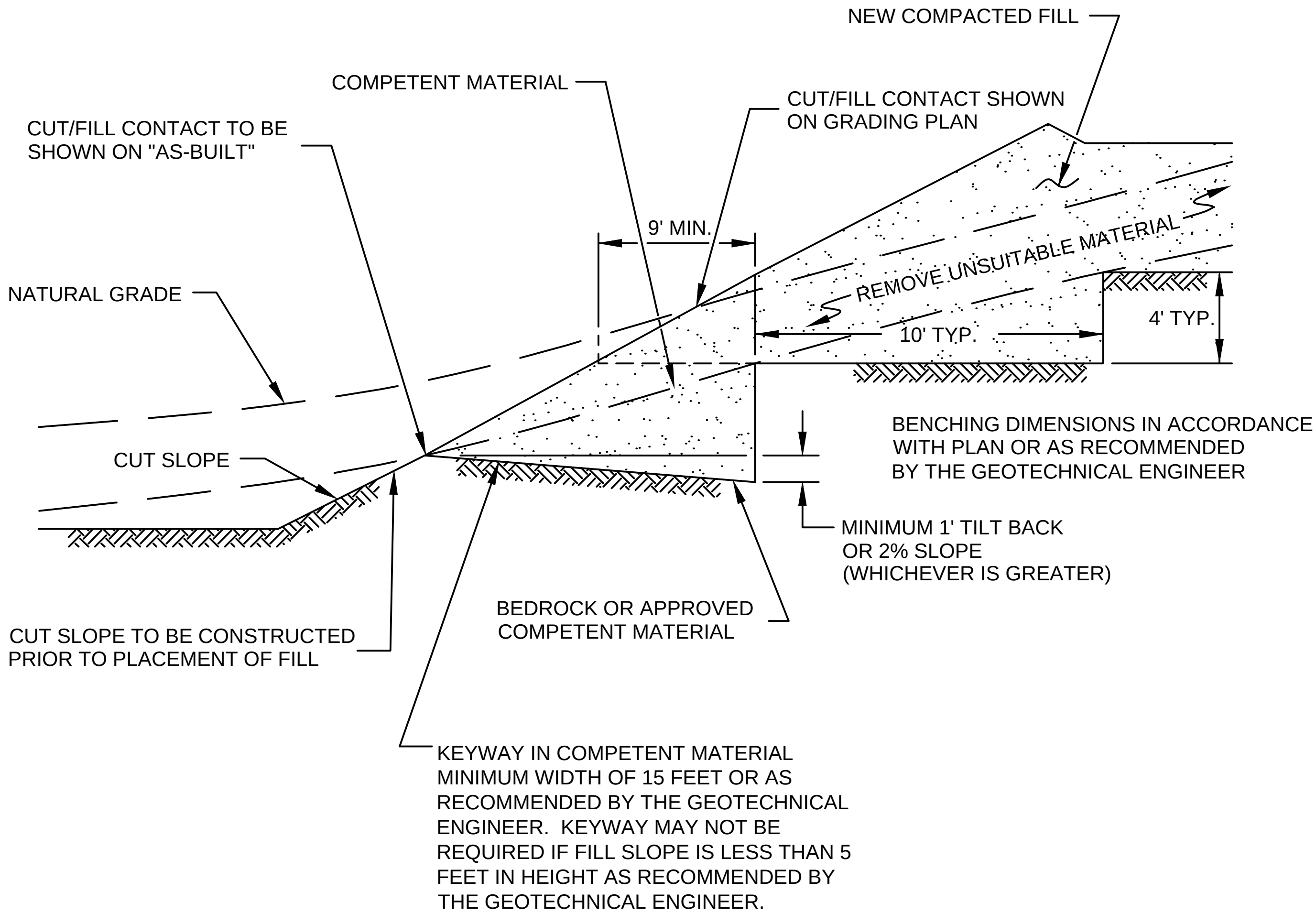
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-1

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL



FILL ABOVE CUT SLOPE DETAIL

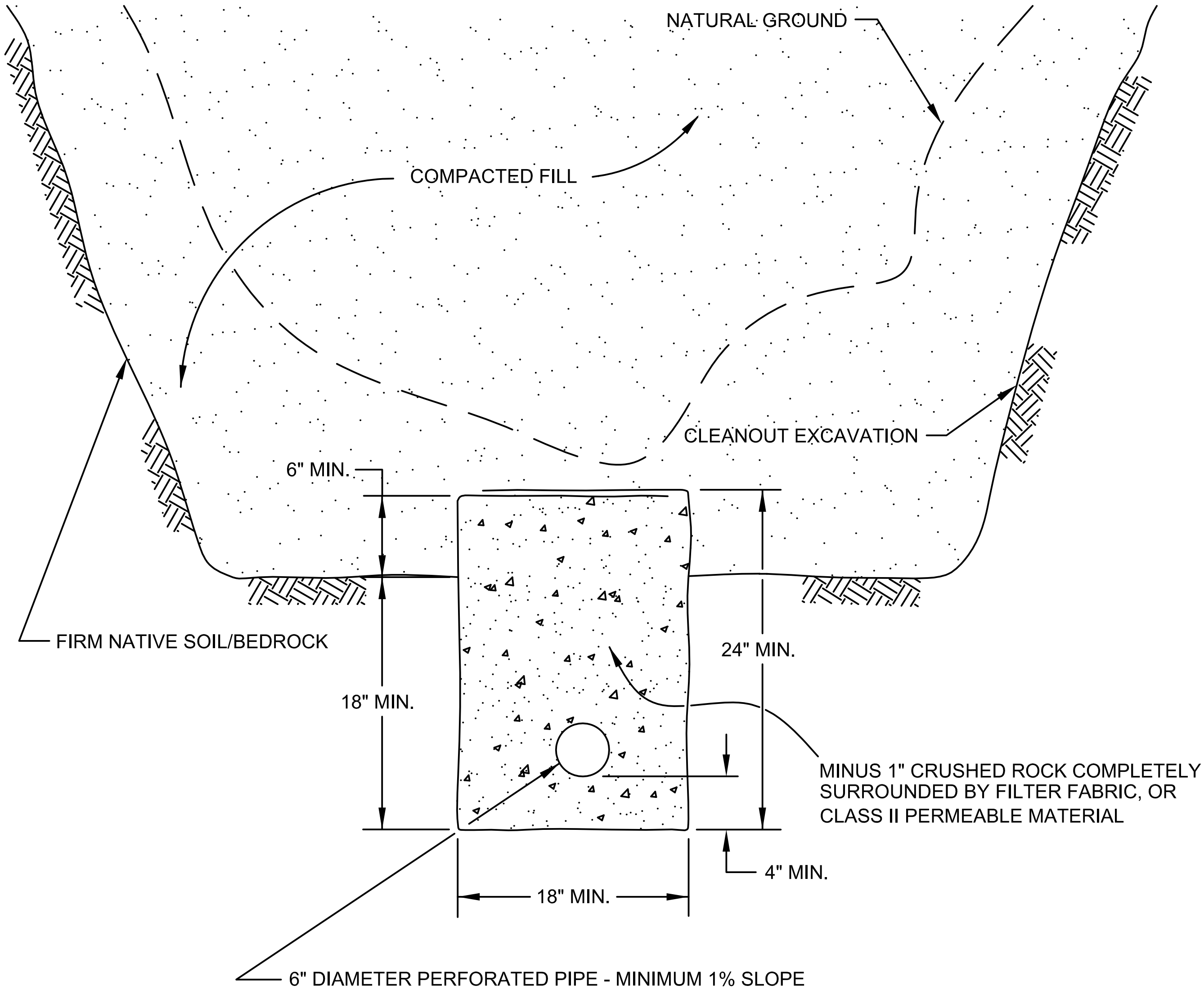
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-2

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL



PIPE MATERIAL	DEPTH OF FILL OVER SUBDRAIN
ADS (CORRUGATED POLETHYLENE)	8
TRANSITE UNDERDRAIN	20
PVC OR ABS: SDR 35	35
SDR 21	100

SCHEMATIC ONLY
NOT TO SCALE

CANYON SUBDRAIN DETAIL

GRADING GUIDE SPECIFICATIONS

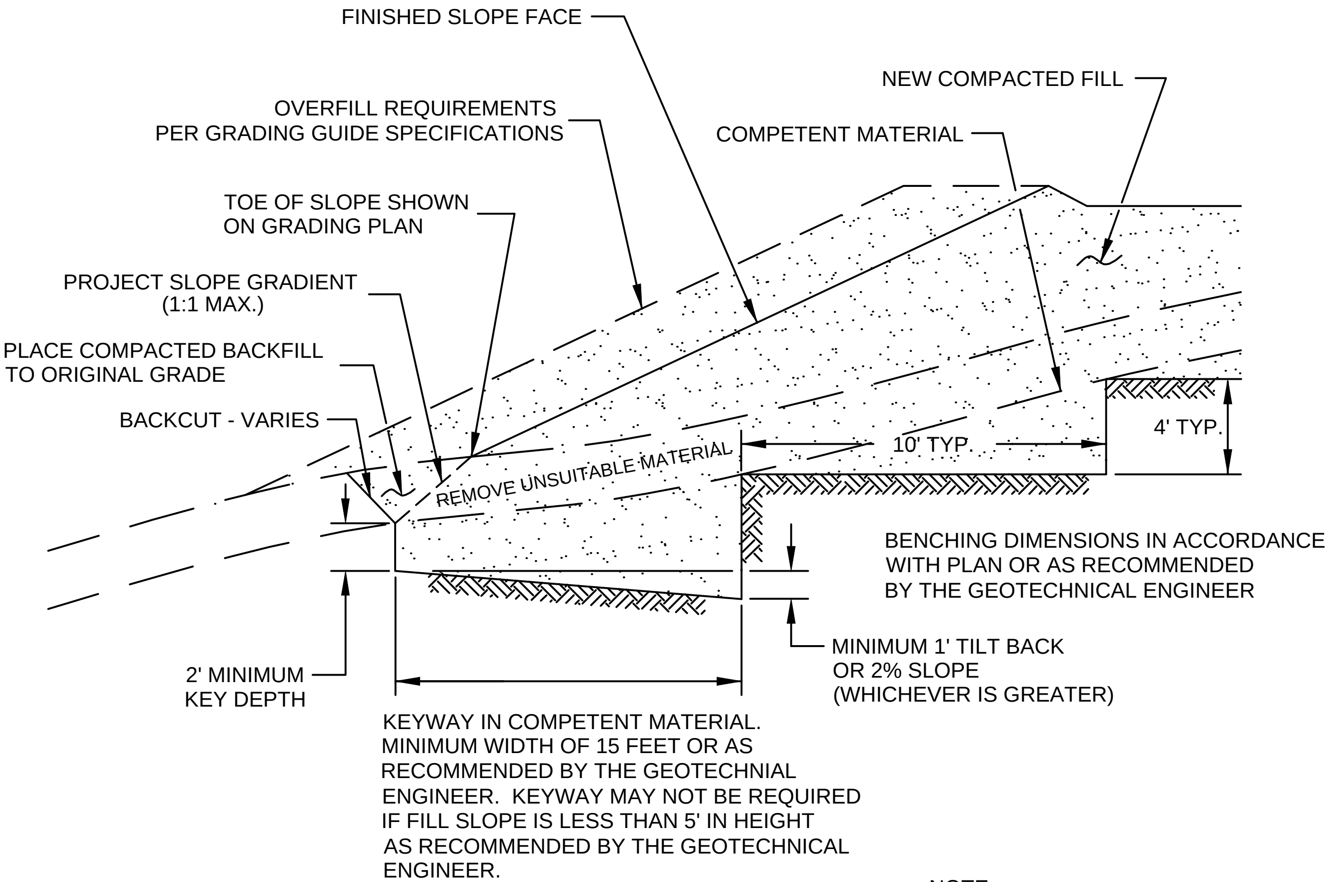
NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-3

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



NOTE:
BENCHING SHALL BE REQUIRED
WHEN NATURAL SLOPES ARE
EQUAL TO OR STEEPER THAN 5:1
OR WHEN RECOMMENDED BY
THE GEOTECHNICAL ENGINEER.

FILL ABOVE NATURAL SLOPE DETAIL

GRADING GUIDE SPECIFICATIONS

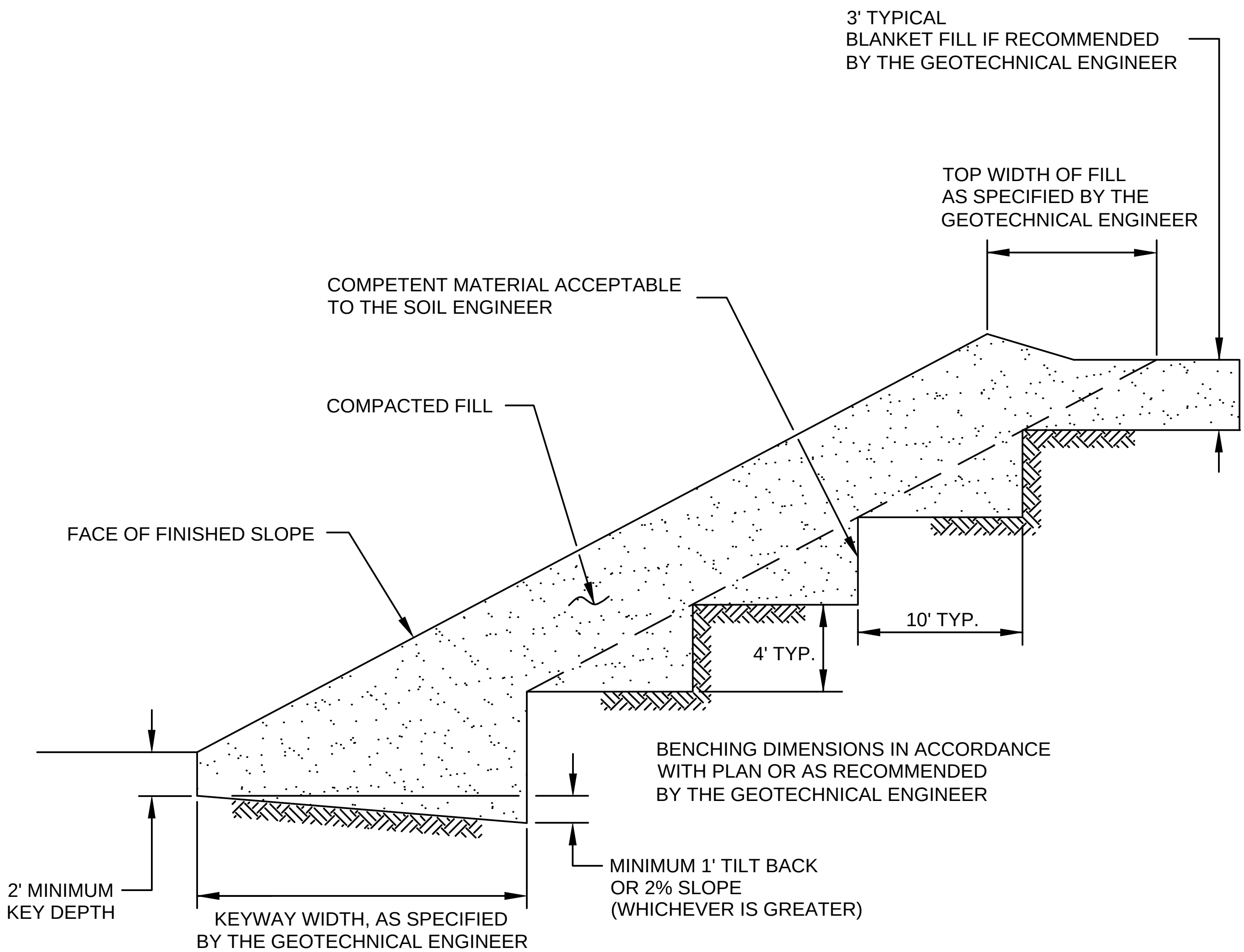
NOT TO SCALE

DRAWN: JAS
CHKD: GKM

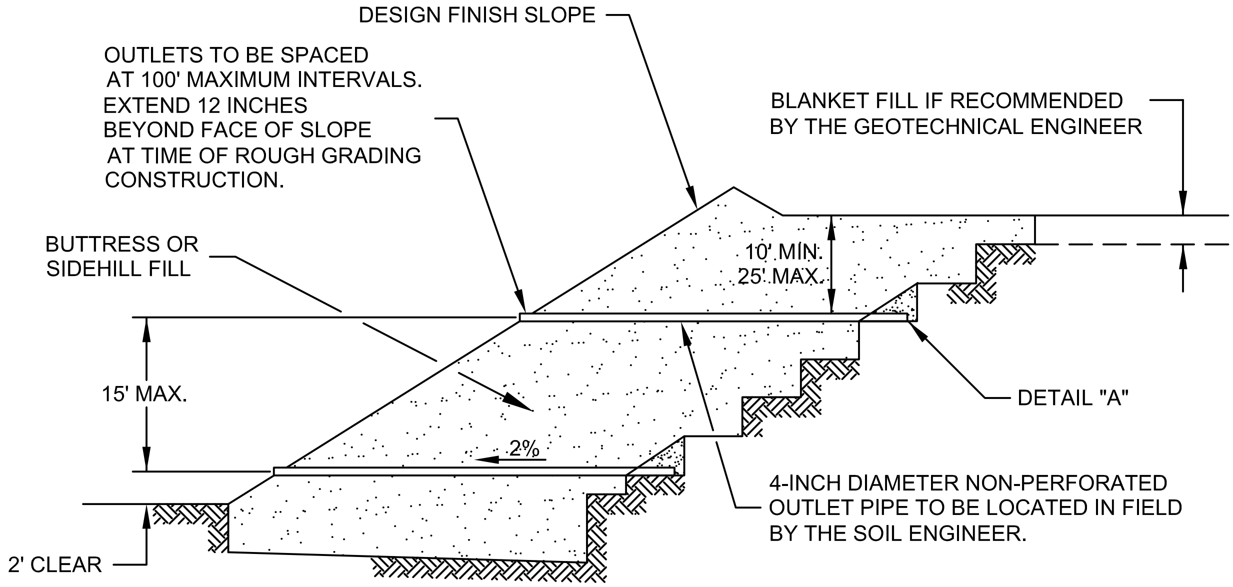
PLATE D-4

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL



STABILIZATION FILL DETAIL	
GRADING GUIDE SPECIFICATIONS	
NOT TO SCALE	SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: JAS CHKD: GKM	
PLATE D-5	



"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO EMA STD. PLAN 323)

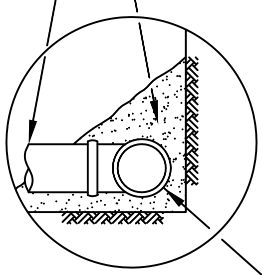
SIEVE SIZE	PERCENTAGE PASSING
1"	100
3/4"	90-100
3/8"	40-100
NO. 4	25-40
NO. 8	18-33
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

SIEVE SIZE	MAXIMUM PERCENTAGE PASSING
1 1/2"	100
NO. 4	50
NO. 200	8

SAND EQUIVALENT = MINIMUM OF 50

OUTLET PIPE TO BE CONNECTED TO SUBDRAIN PIPE WITH TEE OR ELBOW



FILTER MATERIAL - MINIMUM OF FIVE CUBIC FEET PER FOOT OF PIPE. SEE ABOVE FOR FILTER MATERIAL SPECIFICATION.

ALTERNATIVE: IN LIEU OF FILTER MATERIAL FIVE CUBIC FEET OF GRAVEL PER FOOT OF PIPE MAY BE ENCASED IN FILTER FABRIC. SEE ABOVE FOR GRAVEL SPECIFICATION.

FILTER FABRIC SHALL BE MIRAFI 140 OR EQUIVALENT. FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 12 INCHES ON ALL JOINTS.

MINIMUM 4-INCH DIAMETER PVC SCH 40 OR ABS CLASS SDR 35 WITH A CRUSHING STRENGTH OF AT LEAST 1,000 POUNDS, WITH A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE. PROVIDE CAP AT UPSTREAM END OF PIPE. SLOPE AT 2 PERCENT TO OUTLET PIPE.

DETAIL "A"

NOTES:
1. TRENCH FOR OUTLET PIPES TO BE BACKFILLED WITH ON-SITE SOIL.

SLOPE FILL SUBDRAINS

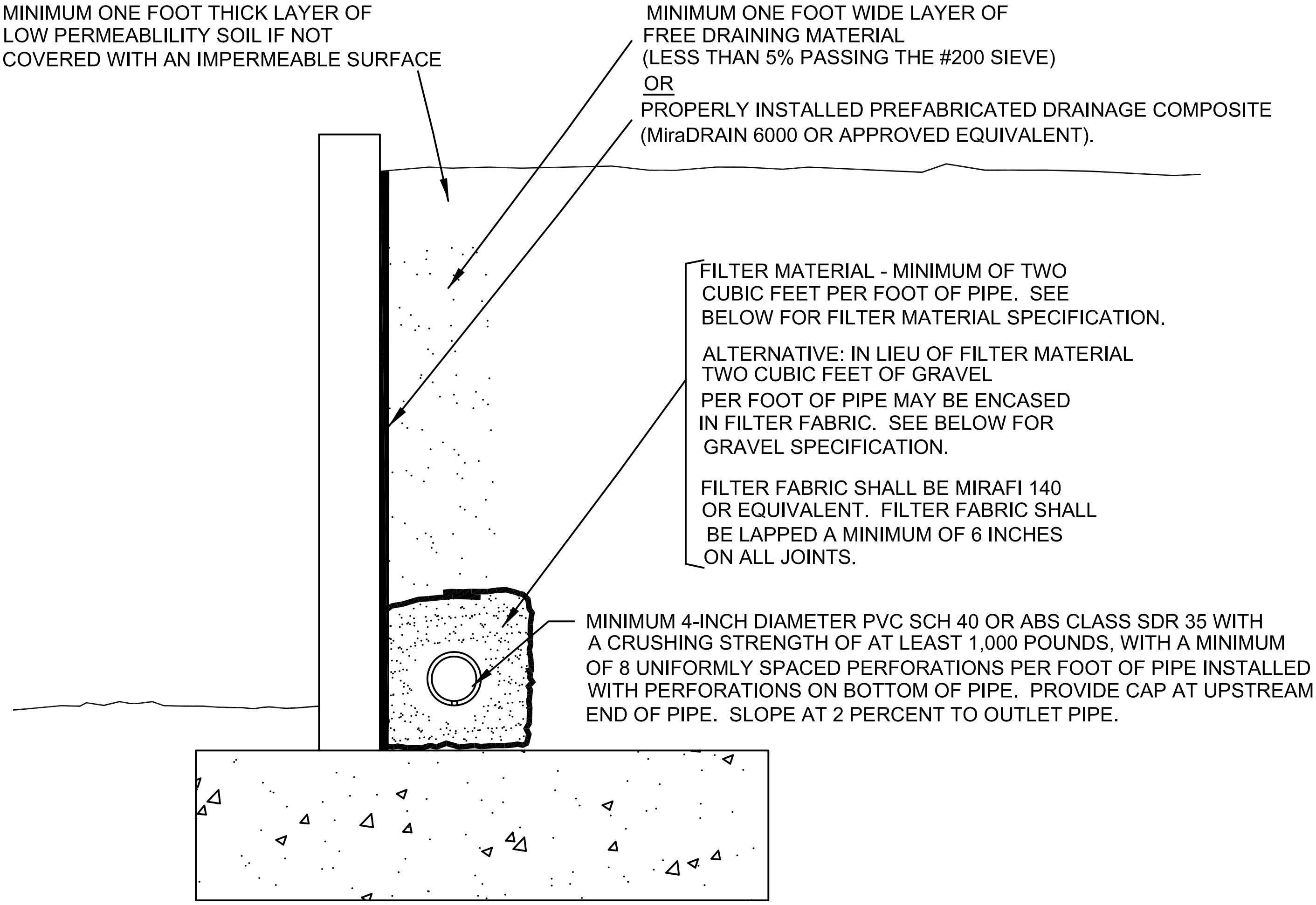
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: JAS
CHKD: GKM

PLATE D-6

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL



"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO EMA STD. PLAN 323)

SIEVE SIZE	PERCENTAGE PASSING
1"	100
3/4"	90-100
3/8"	40-100
NO. 4	25-40
NO. 8	18-33
NO. 30	5-15
NO. 50	0-7
NO. 200	0-3

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

SIEVE SIZE	MAXIMUM PERCENTAGE PASSING
1 1/2"	100
NO. 4	50
NO. 200	8

SAND EQUIVALENT = MINIMUM OF 50

RETAINING WALL BACKDRAINS

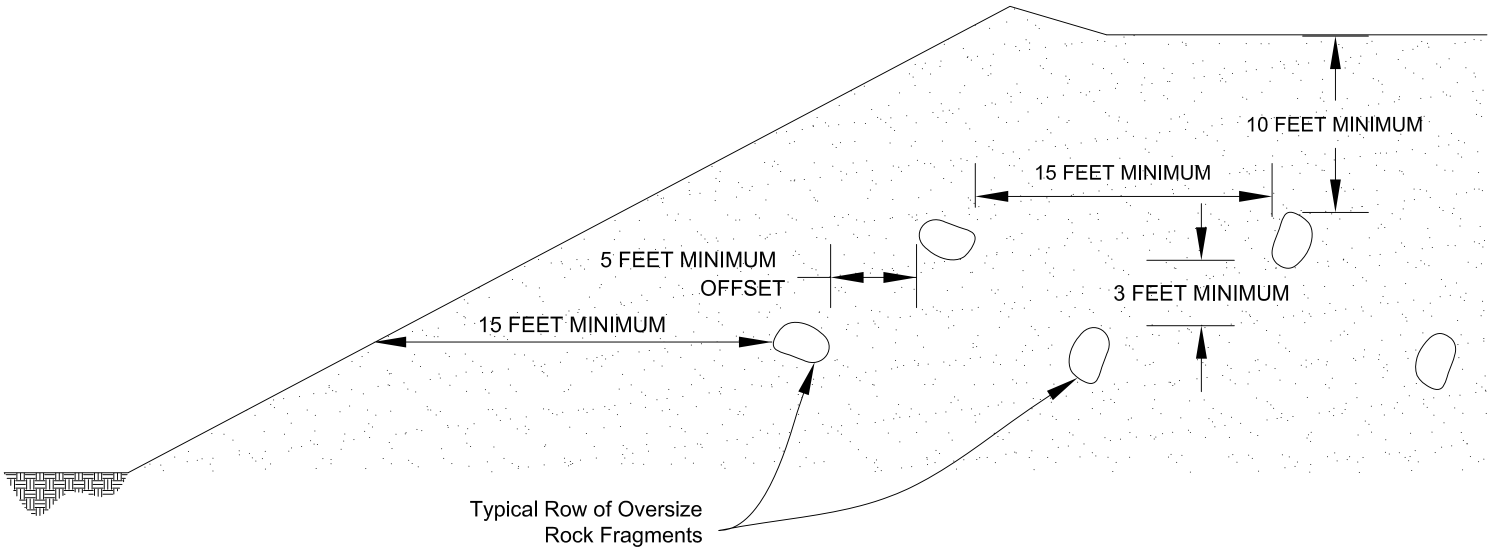
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

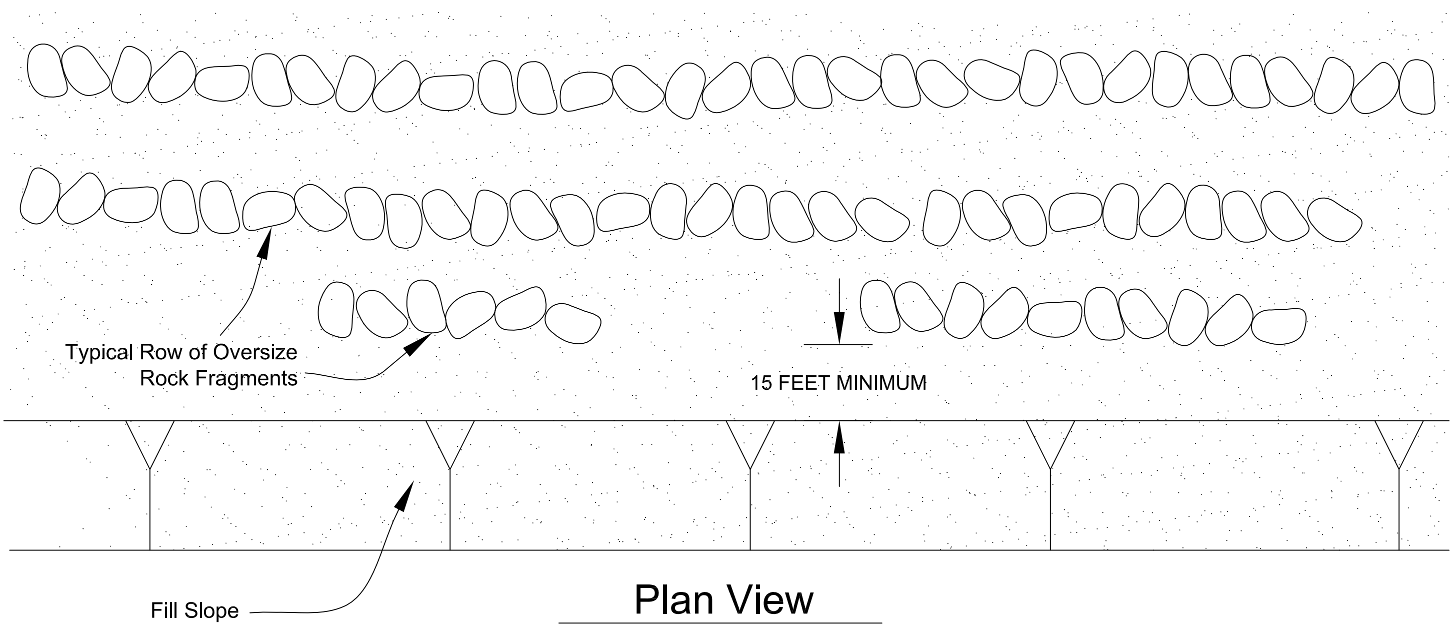
DRAWN: JAS
CHKD: GKM

PLATE D-7

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL



Section View



Plan View

PLACEMENT OF OVERSIZED MATERIAL

GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: PM
CHKD: GKM

PLATE D-8

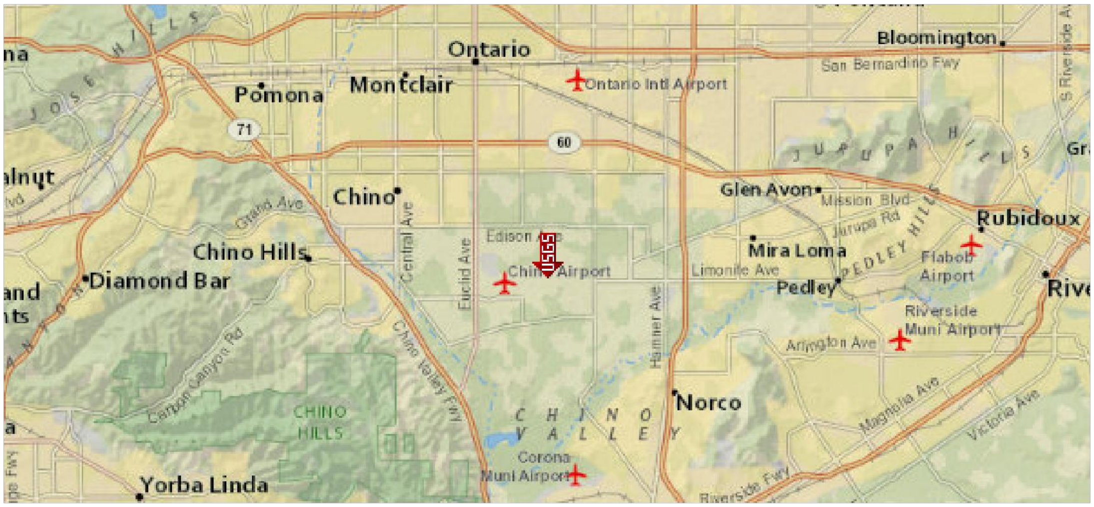
SoCalGeo
SOUTHERN
CALIFORNIA
GEOTECHNICAL

APPENDIX E

USGS Design Maps Summary Report

User–Specified Input

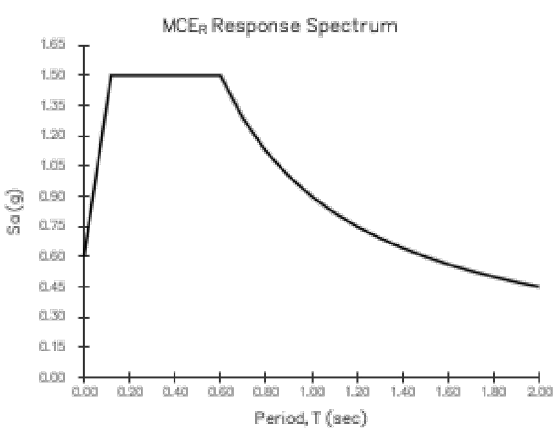
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	33.98637°N, 117.61606°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	I/II/III

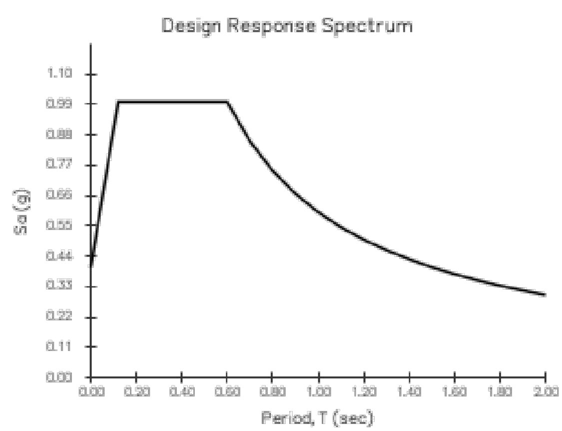


USGS–Provided Output

S_S =	1.500 g	S_{MS} =	1.500 g	S_{DS} =	1.000 g
S_1 =	0.600 g	S_{M1} =	0.900 g	S_{D1} =	0.600 g

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





SOURCE: U.S. GEOLOGICAL SURVEY (USGS)
<http://geohazards.usgs.gov/designmaps/us/application.php>

SEISMIC DESIGN PARAMETERS

PROPOSED COMMERCIAL/INDUSTRIAL DEVELOPMENT

ONTARIO, CALIFORNIA

DRAWN: AL
CHKD: RGT

SCG PROJECT
17G129-1

PLATE E-1

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL

APPENDIX F

May 8, 2017 via email: dnielsen@socalgeo.com

SOUTHERN CALIFORNIA GEOTECHNICAL
22885 E. Savi Ranch Parkway, Suite E
Yorba Linda, CA 92887

Attention: Mr. Daniel Nielsen, PE

Re: Soil Corrosivity Study
LPT C/I Bldgs
Ontario, California
HDR #17-0252SCS, SG #17G129

Introduction

Laboratory tests have been completed on three soil samples provided for the referenced project. The purpose of these tests was to determine if the soils might have deleterious effects on underground utility piping and concrete structures. HDR Engineering, Inc. (HDR) assumes that the samples provided are representative of the most corrosive soils at the site.

The proposed project consists of two to four concrete tilt-up buildings with one story and no subterranean levels. The site is located at 8643 Eucalyptus Avenue in Ontario, California, and the water table is reportedly greater than 30 feet deep. Prior uses of the site include dairy farming.

The scope of this study is limited to a determination of soil corrosivity and general corrosion control recommendations for materials likely to be used for construction. HDR's recommendations do not constitute, and are not meant as a substitute for, design documents for the purpose of construction. If the architects and/or engineers desire more specific information, designs, specifications, or review of design, HDR will be happy to work with them as a separate phase of this project.

431 W. Baseline Road, Claremont, CA 91711-1608
(909) 626-0967

Laboratory Soil Corrosivity Tests

The electrical resistivity of each sample was measured in a soil box per ASTM G187 in its as-received condition and again after saturation with distilled water. Resistivities are at about their lowest value when the soil is saturated. The pH of the saturated samples was measured per CTM 643. A 5:1 water:soil extract from each sample was chemically analyzed for the major soluble salts commonly found in soil per ASTM D4327, ASTM D6919, and Standard Method 2320-B[1]. Laboratory test results are shown in the attached Table 1.

Soil Corrosivity

A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. Corrosion currents, following Ohm's Law, are inversely proportional to soil resistivity. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil.

A correlation between electrical resistivity and corrosivity toward ferrous metals is:[2]

Soil Resistivity in ohm-centimeters	Corrosivity Category
Greater than 10,000	Mildly Corrosive
2,001 to 10,000	Moderately Corrosive
1,001 to 2,000	Corrosive
0 to 1,000	Severely Corrosive

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

---

[1] American Public Health Association (APHA). 2012. Standard Methods of Water and Wastewater. 22nd ed. American Public Health Association, American Water Works Association, Water Environment Federation publication. APHA, Washington D.C.

[2] Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, pp. 166–167.

Electrical resistivities were in the mildly and moderately corrosive categories with as-received moisture. When saturated, the resistivities were in the moderately to severely corrosive categories. The resistivities dropped considerably with added moisture because the samples were dry as-received.

Soil pH values varied from 7.3 to 7.5. This range is neutral to mildly alkaline.[3] These values do not particularly increase soil corrosivity.

The soluble salt content was very high in the sample from boring B-3 and low in the others. Chloride and sulfate salts were the predominant constituents. Chloride is particularly corrosive to ferrous metals, and in the highest concentration measured in the soil samples, chloride can overcome the corrosion inhibiting effect of concrete on reinforcing steel.

Sulfate concentrations were negligible.

The nitrate concentration was high enough to be aggressive to copper.

Tests were not made for sulfide and oxidation-reduction (redox) potential because these samples did not exhibit characteristics typically associated with anaerobic conditions.

This soil is classified as severely corrosive to ferrous metals, aggressive to copper, and aggressive with respect to exposure of reinforcing steel to the migration of chloride.

Corrosion Control Recommendations

The life of buried materials depends on thickness, strength, loads, construction details, soil moisture, etc., in addition to soil corrosivity, and is, therefore, difficult to predict. Of more practical value are corrosion control methods that will increase the life of materials that would be subject to significant corrosion.

The following recommendations are based on the soil conditions discussed in the Soil Corrosivity section above. Unless otherwise indicated, these recommendations apply to the entire site or alignment.

---

[3] *Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, p. 8.*

Steel Pipe

Implement *all* the following measures:

1. Underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints should be bonded for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.
2. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:
    a. At each end of the pipeline.
    b. At each end of all casings.
    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.
3. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically isolate each buried steel pipeline per NACE SP0286 from:
    a. Dissimilar metals.
    b. Dissimilarly coated piping (cement-mortar vs. dielectric).
    c. Above ground steel pipe.
    d. All existing piping.
4. Implement the following:
    a. Apply a suitable dielectric coating intended for underground use such as:
        i. Polyurethane per AWWA C222 *or*
        ii. Extruded polyethylene per AWWA C215 *or*
        iii. A tape coating system per AWWA C214 *or*
        iv. Hot applied coal tar enamel per AWWA C203 *or*
        v. Fusion bonded epoxy per AWWA C213.

    b. Apply cathodic protection to steel piping as per NACE SP0169.

NOTE: Some steel piping systems, such as for oil, gas, and high-pressure piping systems, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Iron Pipe

Implement *all* the following measures:

1. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE SP0286.

2. Bond all nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.

3. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:

    a. At each end of the pipeline.

    b. At each end of any casings.

    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

4. Implement the following:

    a. Apply a suitable coating intended for underground use such as:

        i. Polyethylene encasement per AWWA C105; *or*

        ii. Epoxy coating; *or*

        iii. Polyurethane; *or*

        iv. Wax tape.

        NOTE: The thin factory-applied asphaltic coating applied to ductile iron pipe for transportation and aesthetic purposes does not constitute a corrosion control coating.

b. Apply cathodic protection to cast and ductile iron piping as per NACE SP0169.

Copper Tubing

Implement *all* the following measures:

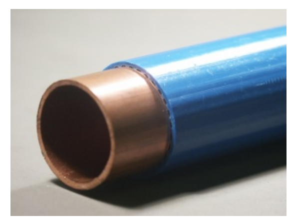
1. Electrically insulate underground copper pipe from dissimilar metals and from above ground copper pipe with insulating devices per NACE SP0286.

2. Electrically insulate cold water piping from hot water piping systems.

3. Protect buried copper tubing by one of the following measures:

    a. Prevention of soil contact. Soil contact may be prevented by placing the tubing above ground or encasing the tubing using PVC pipe with solvent-welded joints.

    b. Installation of a factory-coated copper pipe with a minimum 25-mil thickness such as Kamco's Aqua Shield™, Mueller's Streamline Protec™, or equal. The coating must be continuous with no cuts or defects.



    c. Installation of 12-mil polyethylene pipe wrapping tape with butyl rubber mastic over a suitable primer. Protect wrapped copper tubing by applying cathodic protection per NACE SP0169.

Plastic and Vitrified Clay Pipe

1. No special precautions are required for plastic and vitrified clay piping placed underground from a corrosion viewpoint.

2. Protect all metallic fittings and valves with wax tape per AWWA C217 or epoxy.

All Pipe

1. On all pipes, appurtenances, and fittings not protected by cathodic protection, coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA C217 after assembly.

2. Where metallic pipelines penetrate concrete structures such as building floors, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

Concrete Structures and Pipe

1. From a corrosion standpoint, any type of ASTM C150 cement may be used for concrete structures and pipe because the sulfate concentration is negligible, from 0 to 0.10 percent.[4,5,6]

2. Chloride concentrations were measured at levels[7] where additional protective measures are required for concrete. Protect steel and iron embedded in concrete structures and pipe from chloride attack. This applies to such items as reinforcing steel and anchor bolts but not post-tensioning strands and anchors, which have separate requirements. The protection could be one or a combination of the following:

    a. Protective Concrete - A concrete mix designed to protect embedded steel and iron should be based on the following parameters: 1) a chloride content of 1,000 ppm in the soil; 2) the desired service life; the design 3) concrete cover; and 4) the applicable building code. A protective concrete mix may include a corrosion inhibitor admixture and/or supplementary cementitious materials.

    b. Waterproof Concrete - Waterproofing for concrete could be a gravel capillary break under the concrete, a waterproof membrane such as Grace PrePrufe® products, and/or a liquid applied waterproof barrier coating. Visqueen, similar rolled barriers, or bentonite-based membranes are not viable waterproofing systems, from a corrosion standpoint.

    c. Coat Embedded Metal - A coating for embedded steel and iron could be an epoxy coating applied to the metal. Purple fusion bonded epoxy (FBE)

---

[4] *2015 International Building Code (IBC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[5] *2012 International Residential Code (IRC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[6] *2013 California Building Code (CBC) which refers to American Concrete Institute (ACI) 318 Table 19.3.2.1*

[7] *Design Manual 303: Concrete Cylinder Pipe. Ameron. p.65*

(ASTM A934) intended for prefabricated reinforcing steel reinforcing steel is suitable. Any damage to the coating must be repaired in accordance with the manufacturer's specifications prior to installation. The green flexible FBE (ASTM A775) is not recommended.

d. Cathodic Protection - Cathodic protection is most practical for pipelines and must be designed for each application. The amount of cathodic protection current needed can be minimized by coating the steel or iron.

Closure

The analysis and recommendations presented in this report are based upon data obtained from the laboratory samples. This report does not reflect variations that may occur across the site or due to the modifying effects of construction. If variations appear, HDR should be notified immediately so that further evaluation and supplemental recommendations can be provided.

HDR's services have been performed with the usual thoroughness and competence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

Please call if you have any questions.

Respectfully Submitted,
HDR Engineering, Inc.

James Keegan

Greg Frost, PE

Enc: Table 1

Table 1 - Laboratory Tests on Soil Samples

Southern California Geotechnical
LPT C/I Bldgs
Your #17G129, HDR Lab #17-0252SCS
5-May-17

Sample ID

			B-3	B-9	B-6
Resistivity		**Units**			
as-received		ohm-cm	8,000	12,400	16,000
saturated		ohm-cm	440	2,200	3,960
pH			7.5	7.3	7.3
Electrical Conductivity		mS/cm	1.09	0.16	0.08
Chemical Analyses					
Cations					
calcium	Ca^{2+}	mg/kg	35	27	21
magnesium	Mg^{2+}	mg/kg	17	7.9	6.4
sodium	Na^{1+}	mg/kg	435	41	23
potassium	K^{1+}	mg/kg	906	58	9.8
Anions					
carbonate	CO_3^{2-}	mg/kg	41	ND	ND
bicarbonate	HCO_3^{1-}	mg/kg	220	92	70
fluoride	F^{1-}	mg/kg	1.5	3.5	1.8
chloride	Cl^{1-}	mg/kg	983	52	19
sulfate	SO_4^{2-}	mg/kg	490	26	11
phosphate	PO_4^{3-}	mg/kg	ND	1.5	ND
Other Tests					
ammonium	NH_4^{1+}	mg/kg	ND	ND	ND
nitrate	NO_3^{1-}	mg/kg	16	237	116
sulfide	S^{2-}	qual	na	na	na
Redox		mV	na	na	na

Resistivity per ASTM G187, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B.
Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction potential in millivolts
ND = not detected
na = not analyzed

431 West Baseline Road · Claremont, CA 91711
Phone: 909.962.5485 · Fax: 909.626.3316