

**GEOTECHNICAL INVESTIGATION  
PROPOSED COMMERCIAL/INDUSTRIAL  
DEVELOPMENT**

NWC Merrill Avenue and Carpenter Avenue  
Ontario, California  
for  
ProLogis



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
*A California Corporation*

August 21, 2018

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**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
*A California Corporation*

Attention: Mr. Tom Donahue  
Director, Construction & Development

Project No.: **18G174-1**

Subject: **Geotechnical Investigation**  
Proposed Commercial/Industrial Development  
NWC Merrill Avenue and Carpenter 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.**

Robert G. Trazo, GE 2655  
Principal Engineer



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Distribution: (1) Addressee

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# 1.0 EXECUTIVE SUMMARY

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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 residences, 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 processed 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, with thickness of 2 to 3± inches at the boring and trench locations.
- 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 areas. Additionally, artificial fill soils were encountered in isolated areas extending to depths of 2½ to 6½± 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 3 feet below the proposed building pad subgrade elevations. Within the influence zones of new foundations, the overexcavation should extend to a depth of at least 3 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 0 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<sup>2</sup>.
- 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**

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The scope of services performed for this project was in accordance with our Proposal No. 18P326, dated July 23, 2018. 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 slabs, 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 northwest corner of Carpenter Avenue and Merrill Avenue in Ontario, California. The site is bounded to the north by Eucalyptus Avenue, to the west by a dairy farm, to the south by Merrill Avenue, and to the east by Carpenter Avenue. 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 consists of several rectangular-shaped parcels which total 65± acres. The northeastern area of the site is an active dairy farm with multiple canopy structures, three (3) single-family residences, and a milking parlor. The southeastern and east-central area of the site is utilized for cattle washout areas and includes numerous detention basins approximately 6 to 25 feet deep. The western half of the site is developed as a trucking facility. Several commercial structures are located in the southern area of the site. These buildings range from 8,000 to 13,000± ft<sup>2</sup> in size and are of metal construction. Two single-family residences are located along the southern property line and one single-family residence is located along the northern property line. The residences are of wood frame and stucco construction. All these structures are assumed to be supported on conventional shallow foundations with slab-on-grade floors. The ground surface cover consists of asphaltic concrete, Portland cement concrete, and crushed aggregate base (CAB) in the trucking facility areas and exposed soil, manure, and sparse to moderate native grass and weed growth in the dairy areas. The pavements are in fair condition with areas of minor to moderate cracking.

Detailed topographic information was not available at the time of this report. However, based on topographic information obtained from Google Earth, the site topography, with the exception of the detention basins, ranges from 689± feet mean sea level (msl) in the northeastern area of the site to 667± feet msl in the southwestern area of the site. The site topography slopes gently downward toward the southwest at a gradient of approximately 1± percent.

### **3.2 Proposed Development**

Based on a preliminary site plan provided to our office by the client, the site will be developed with three (3) new commercial/industrial buildings. Two buildings will be constructed in the northern area of the site and will be 75,000± ft<sup>2</sup> and 76,000± ft<sup>2</sup> in size. The third building will be constructed in the central area of the site and will be approximately 1,130,000 ft<sup>2</sup> in size. The two northern buildings will be constructed with dock-high doors along a portion of the southern wall and the central building will be constructed with dock-high doors along the east and west walls. The buildings will be surrounded by asphaltic concrete pavements in the parking and drive lane areas, Portland cement concrete pavements in the loading dock areas, concrete flatwork and landscape planters throughout.

Detailed structural information has not been provided. It is assumed that the buildings will be one-story structures of tilt-up concrete construction, typically supported on conventional shallow foundations with concrete slab-on-grade floors. Based on the assumed construction, maximum

column and wall loads are expected to be on the order of 100 kips and 4 to 7 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 areas. The proposed structures are not expected to incorporate any significant below grade construction such as basements or crawl spaces.



## **4.0 SUBSURFACE EXPLORATION**

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### **4.1 Scope of Exploration/Sampling Methods**

The subsurface exploration conducted for this project consisted of twelve (12) borings advanced to depths of 15 to 30± feet below existing site grades. In addition to the borings, five (5) trenches were excavated at the site to depths of 5 to 10± feet below existing site grades. All of the borings and trenches were logged during exploration by members of our staff.

The trenches were excavated using a rubber tire backhoe with a 24-inch-wide bucket. The borings were advanced with hollow-stem augers, by a truck-mounted drilling rig. Representative bulk and undisturbed soil samples were taken during drilling. Relatively undisturbed 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 2 in Appendix A of this report. 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**

#### **Pavements and Ground Surface Cover**

Asphaltic concrete pavements were encountered at the ground surface at Boring Nos. B-8 and B-10. At these locations, the pavement section consists of 3± inches of asphaltic concrete with 7± inches of underlying aggregate base.

Boring Nos. B-1, B-2, B-5, B-7, and B-11 encountered a layer of aggregate base at the ground surface. At these locations, the base layer measures 3 to 5± inches thick.

Manure was encountered at the ground surface at Boring Nos. B-3, B-4, B-6, B-9 and at Trench Nos. T-1 and T-2. The manure is approximately 2 to 3 inches thick.

#### **Artificial Fill**

Artificial fill soils were encountered at the ground surface at Boring No. B-12 and below the aggregate base, asphaltic concrete, or manure at Boring Nos. B-2, B-5, B-8, B-9, B-10, and B-11. The fill soils generally consist of loose to dense fine sand, silty sands to sandy silts, clayey fine to

medium sands, and very stiff silty clay, extending to depths of 2½ to 6½± feet below existing site grades. The fill soils possess a disturbed appearance resulting in their classification as artificial fill.

### Alluvium

Native alluvial soils were encountered at the ground surface at Trench Nos. T-3 through T-5 and beneath the fill soils/aggregate base/manure/pavements at all of the other trench and boring locations. The alluvium generally includes loose to dense silty sands to sandy silts, fine to medium sands, and clayey fine sands. The alluvium also consists of medium stiff to hard clayey silts to silty clays and fine sandy clays. The alluvial soils extend to at least the maximum depth explored of 30± feet below existing site grades.

### 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 1.6± miles west from the site, indicate a high groundwater level of 83± feet below ground surface.

## 5.0 LABORATORY TESTING

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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-13 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.

<b><u>Sample Identification</u></b>	<b><u>Soluble Sulfates (%)</u></b>	<b><u>ACI Classification</u></b>
B-4 @ 0 to 5 feet	0.025	Not Applicable (S0)
B-9 @ 0 to 5 feet	0.016	Not Applicable (S0)
B-11 @ 0 to 5 feet	0.025	Not Applicable (S0)

### Maximum Dry Density and Optimum Moisture Content

Representative bulk samples were 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-14 through C-16 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.

<b><u>Sample Identification</u></b>	<b><u>Saturated Resistivity (ohm-cm)</u></b>	<b><u>pH</u></b>	<b><u>Chlorides (mg/kg)</u></b>	<b><u>Nitrates (mg/kg)</u></b>
B-4 @ 0 to 5 feet	328	8.3	398	197
B-9 @ 0 to 5 feet	760	7.2	121	1,140
B-11 @ 0 to 5 feet	760	7.8	120	384

### 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:

<b><u>Sample Identification</u></b>	<b><u>Expansion Index</u></b>	<b><u>Expansive Potential</u></b>
B-2 @ 0 to 5 feet	0	Very Low
B-11 @ 0 to 5 feet	2	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:

<b><u>Sample Identification</u></b>	<b><u>Organic Content (%)</u></b>
T-1 @ 0 to 6 inches	11.8
T-1 @ 6 to 12 inches	2.1
T-1 @ 12 to 18 inches	4.5
T-1 @ 18 to 24 inches	0.7
T-2 @ 0 to 6 inches	69.3
T-2 @ 6 to 12 inches	2.2
T-2 @ 12 to 18 inches	0.9
T-2 @ 18 to 24 inches	1.0

## **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 recommendations are provided with the assumption that an adequate program of client consultation, construction monitoring, and testing will be performed during the final design and construction phases to verify compliance with these recommendations. Maintaining Southern California Geotechnical, Inc., (SCG) as the geotechnical consultant from the beginning to the end of the project will provide continuity of services. The geotechnical engineering firm providing testing and observation services shall assume the responsibility of 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 two mile radius from the site indicates a high groundwater level of 83± 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 2 to 3± 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 from 2½ to 6½± feet in thickness. 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 basins located in 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 will likely possess elevated moisture contents. Some drying of the overexcavation subgrade and excavated soils in these areas will likely be necessary, prior to compaction as structural fill.

### **Settlement**

The proposed remedial grading will remove a portion of the loose, low strength, and potentially collapsible/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 = 0 and 2). Based on these test results, 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

The results of laboratory testing indicate that the on-site soils possess resistivity values ranging from 328 to 760 ohm-cm, and pH values ranging from 7.2 to 8.3. These test results have been evaluated in accordance with guidelines published by the Ductile Iron Pipe Research Association (DIPRA). The DIPRA guidelines consist of a point system by which characteristics of the soils are used to quantify the corrosivity characteristics of the site. Sulfides, and redox potential are factors that are also used in the evaluation procedure. We have evaluated the corrosivity characteristics of the on-site soils using resistivity, pH, and moisture content. Based on these factors, and utilizing the DIPRA procedure, **the on-site soils are considered to be severely corrosive to ductile iron pipe. Therefore, it is expected that polyethylene encasement or some other appropriate method of protection will be required for iron pipes.** Since SCG does not practice in the area of corrosion engineering, the client may also wish to contact a corrosion engineer to provide a more thorough evaluation.

Based on American Concrete Institute (ACI) Publication 318 Building Code Requirements for Structural Concrete and Commentary, reinforced concrete that is exposed to external sources of chlorides requires corrosion protection for the steel reinforcement contained within the concrete. ACI 318 defines concrete exposed to moisture and an external source of chlorides as "severe" or exposure category C2. For exposure category C2, ACI 318 prescribes the use of concrete with a compressive strength of 5,000 psi and a maximum water cement ratio of 0.4. ACI 318 does not clearly define a specific chloride concentration at which contact with the adjacent soil will constitute a "C2" or severe exposure. However, the Caltrans Memo to Designers 10-5, Protection of Reinforcement Against Corrosion Due to Chlorides, Acids and Sulfates, dated June 2010, indicates that soils possessing chloride concentrations greater than 500 mg/kg are considered to be corrosive to reinforced concrete. Additionally, based on our conversations with a representative from HDR, Inc., we understand that soils possessing concentrations of 350 mg/kg can also constitute a potentially corrosive chloride exposure for steel within reinforced concrete.

Based on our interpretation of the results of the corrosivity testing and our understanding of the criteria for a "severe" (C2) chloride exposure, soils that can constitute a potentially corrosive exposure are present at one of the boring locations within the site.

**Since SCG does not practice in the area of corrosion engineering, the client should consult with a corrosion engineer to further provide the chloride exposure category for this site with respect to the requirements of ACI 318-14. In accordance with the requirements of ACI 318 for severe or C2 chloride exposure, any reinforced concrete in contact with the on-site soils will require a minimum compressive strength of 5,000 lb/in<sup>2</sup> and a maximum water cement ratio of 0.40.** Measures to protect steel reinforcement are expected to consist of the use of higher strength concrete and/or a lower water-to-cement ratio as described above. However, as an alternative, it may be feasible to blend the on-site soils in order to achieve acceptable chloride contents. The client may also wish to consider additional soil sampling and laboratory testing to determine the extent of the areas of high chloride contents. These results should be reviewed by a corrosion engineer and the geotechnical engineer to provide the appropriate mitigation measures.

### Organic Content

Organic content testing was performed on samples taken from the exploratory trenches in the cattle pen areas and the basin 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 6± inches at Trench Nos. T-1 and T-2 possessed relatively high organic contents of 11.8 percent and 69.3 percent. However, all of the other samples taken from the upper 24± inches at the trench locations possess moderate organic contents ranging between 0.7 and 4.5 percent.

**It is recommended that all manure and any organic topsoil (greater than 5 percent organics) be removed during site stripping. These were present within the upper ½± foot at Trench Nos. T-1 and T-2.** Soils used for structural fills should contain less than 3 percent organic material. Soils containing greater than 3 percent organics may be properly disposed of off-site or utilized within non-structural landscaped areas. Soils possessing minor to moderate organic contents, less than 5 percent by weight, may be blended with soils with lower organic content, provided that the final mixture contains less than 3 percent organics by weight.

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 9 to 17 percent. However, the estimated shrinkage of the individual soil layers at the site is highly variable, locally ranging from a minimum shrinkage value of 8 percent to a maximum shrinkage of 20 percent at varying sample depths and locations. It should be noted that the potential shrinkage estimate is based on dry density testing performed on small-diameter samples taken at the boring locations. If a more accurate and precise shrinkage estimate is desired, SCG can perform a shrinkage study involving several excavated test-pits where in-place densities are determined using in-situ testing methods instead of laboratory density testing on small-diameter samples. Please contact SCG for details and a cost estimate regarding a shrinkage study, if desired.

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.

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, organic debris and soils containing greater than 5 percent organics. 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 2½ to 6½± 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

3 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.

Based on conditions encountered at the exploratory boring locations, moist to very moist soils may be encountered at or near the base of the recommended overexcavation. Stabilization of the exposed overexcavation subgrade soils may be necessary. Scarification and air drying of these materials is expected to be sufficient to obtain a stable subgrade. However, if highly unstable soils are identified, and if the construction schedule does not allow for delays associated with drying, mechanical stabilization, usually consisting of coarse crushed stone or geotextile, could be necessary. In this event, the geotechnical engineer should be contacted for supplementary recommendations.

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 0 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 3 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 areas should extend at least 5 feet beyond the foundation perimeters, and to an extent equal to the depth of fill below the new foundations. Please note that any erection pads used to construct the walls are considered to be part of the foundation system. 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 areas. 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, organic, 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 0 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 ( $6\pm$  inches), near-horizontal lifts, moisture conditioned to 0 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 and organic content to the satisfaction of the geotechnical engineer. Soils possessing less than 3 percent organics may be utilized within structural fills. 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.
- It should be noted that some of the encountered subsurface soils possess moisture contents above the anticipated optimum moisture content. **Therefore, some drying of these materials will likely be required in order to achieve a moisture content suitable for recompaction.**
- 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.

If grading occurs during a period of relatively wet weather, an increase in subgrade instability should also be expected. The site should, therefore, be graded to prevent ponding of surface water and to prevent water from running into excavations. It should be noted that some subsurface soils possess relatively high moisture contents. Subgrade stabilization may be necessary where excavations extend into these soils.

Consideration should be given to using only tracked vehicles once subgrade instability develops. The use of rubber-tired equipment could result in significant pumping and further deterioration of the exposed subgrade.

If the construction schedule dictates that site grading will occur during a period of wet weather, allowances should be made for costs and delays associated with drying the on-site soils or import of a drier, less moisture-sensitive fill material. Grading during wet or cool weather may also increase the depth of overexcavation in the pad areas as well as the need for subgrade stabilization.



## 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 newly placed structural fill soils extending to depths of at least 3 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<sup>2</sup>.
- 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 0 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<sup>3</sup>
- 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<sup>2</sup>.

## **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, extending to a depth of at least 3 feet below finished pad grade. 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 0 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**

<b>Design Parameter</b>		<b>Soil Type</b>
		On-site Silty Sands and Sandy Silts
Internal Friction Angle ( $\phi$ )		30°
Unit Weight		130 lbs/ft <sup>3</sup>
Equivalent Fluid Pressure:	Active Condition (level backfill)	43 lbs/ft <sup>3</sup>
	Active Condition (2h:1v backfill)	70 lbs/ft <sup>3</sup>
	At-Rest Condition (level backfill)	65 lbs/ft <sup>3</sup>

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<sup>3</sup>. 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 3 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.

<b>Traffic Index</b>	<b>No. of Heavy Trucks per Day</b>
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.

<b>ASPHALT PAVEMENTS (R = 40)</b>					
<b>Materials</b>	<b>Thickness (inches)</b>				
	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:

<b>PORTLAND CEMENT CONCRETE PAVEMENTS</b>				
<b>Materials</b>	<b>Thickness (inches)</b>			
	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

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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.

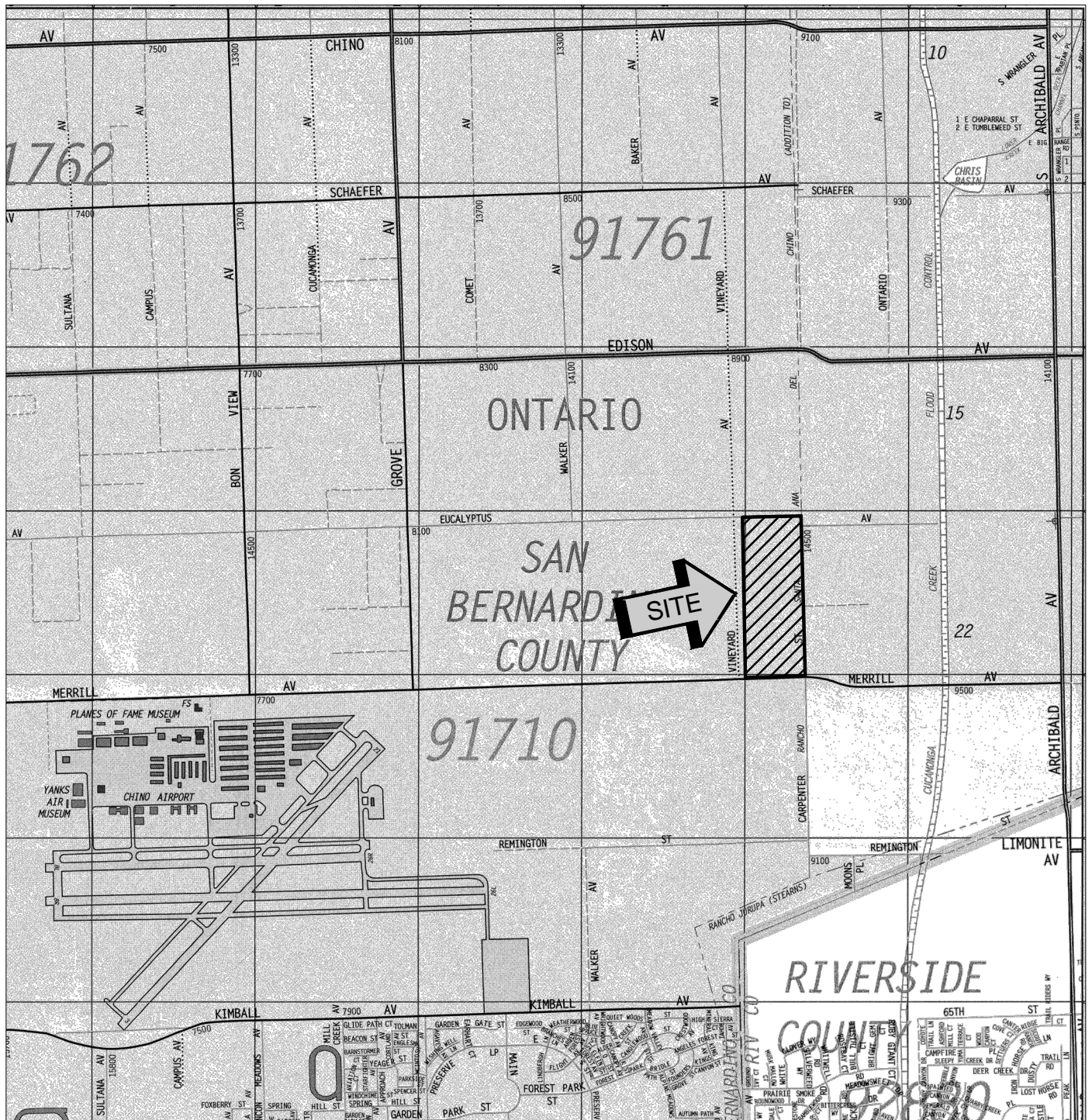
The analysis of this site was based on a subsurface profile interpolated from limited discrete soil samples. While the materials encountered in the project area are considered to be representative of the total area, some variations should be expected between boring locations and sample depths. If the 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



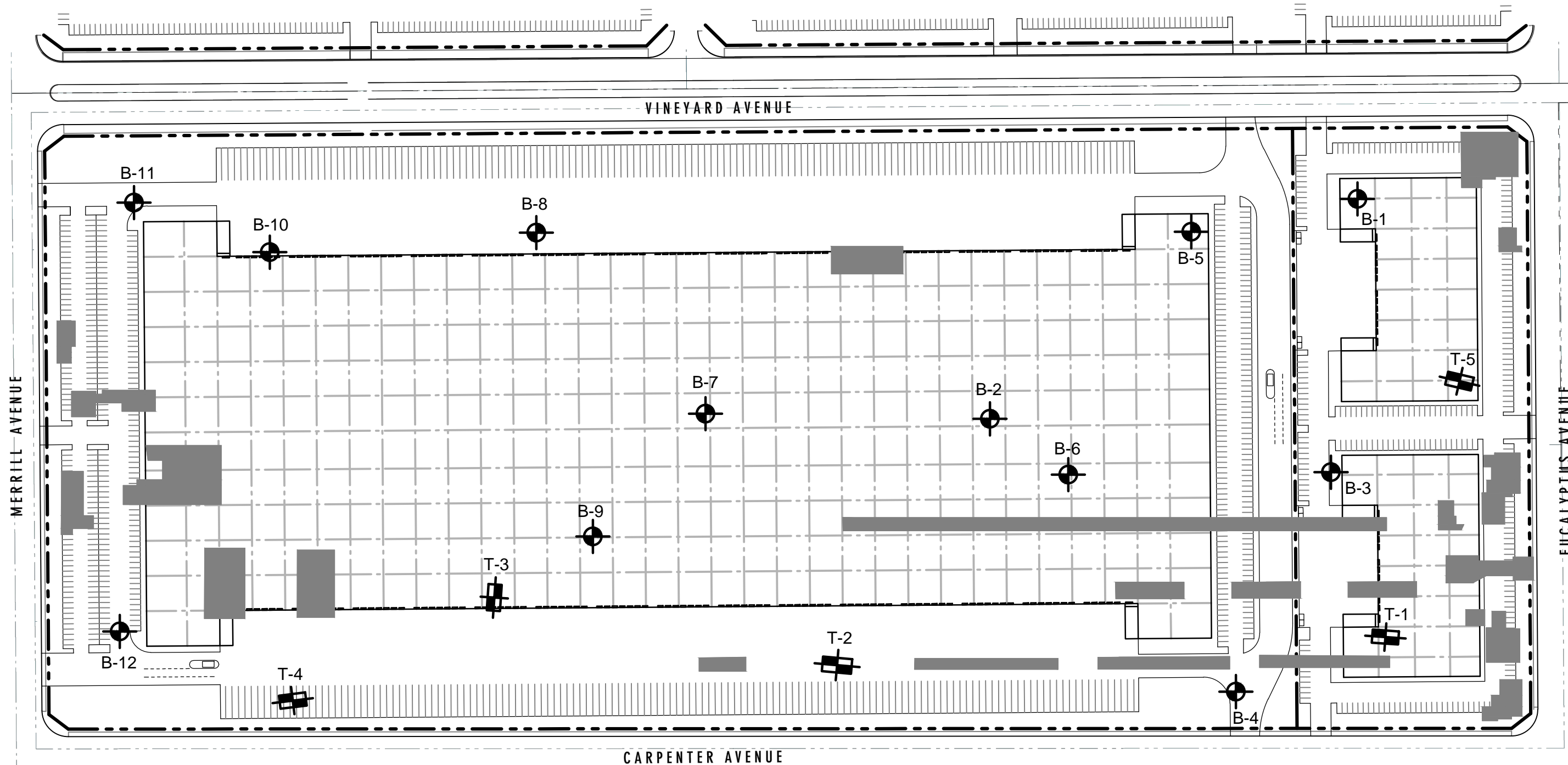
**SITE LOCATION MAP**  
PROPOSED COMMERCIAL/INDUSTRIAL DEVELOPMENT  
ONTARIO, CALIFORNIA

SCALE: 1" = 2400'  
DRAWN: CT  
CHKD: RGT  
SCG PROJECT  
18G174-1  
PLATE 1






**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**





**GEOTECHNICAL LEGEND**

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






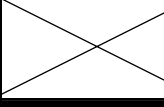




NOTE: BASE MAP PREPARED BY RGA.

<b>BORING AND TRENCH LOCATION PLAN</b>	
PROPOSED COMMERCIAL/INDUSTRIAL DEVELOPMENT	
ONTARIO, CALIFORNIA	
SCALE: 1" = 180'	
DRAWN: JLL CHKD: RGT	
SCG PROJECT 18G174-1	
<b>PLATE 2</b>	
<b>SOUTHERN CALIFORNIA GEOTECHNICAL</b>	

# 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<sup>3</sup>.

### 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



JOB NO.: 18G174	DRILLING DATE: 8/1/18	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 21 feet
LOCATION: Ontario, California	LOGGED BY: Anthony Luna	READING TAKEN: At Completion

FIELD RESULTS				GRAPHIC LOG	DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	
SURFACE ELEVATION: --- MSL												
					4± inches Aggregate base							
					<u>ALLUVIUM:</u> Gray Brown Silty fine Sand, medium dense-damp	104	8					
					Gray Brown fine Sand, some Silt, loose to medium dense-damp	95	6					
5						97	5					
						97	4					
					Gray Brown Silty fine Sand, medium dense-damp to moist	95	10					
10												
					Gray Brown Silty fine Sand to fine Sandy Silt, trace Clay, trace Iron oxide staining, dense-moist		13					
15												
					Brown Silty fine Sand, trace medium Sand, medium dense to dense-damp to moist		10					
20												
							9					
25												
Boring Terminated at 25'												

TBL 18G174.GPJ SOCALGEO.GDT 8/22/18




JOB NO.: 18G174	DRILLING DATE: 8/1/18	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 12 feet
LOCATION: Ontario, California	LOGGED BY: Anthony Luna	READING TAKEN: At Completion

FIELD RESULTS				GRAPHIC LOG	DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	
SURFACE ELEVATION: --- MSL												
					3± inches Aggregate base							El = 0 @ 0 to 5'
		29			FILL: Dark Gray Brown Silty fine Sand, trace medium to coarse Sand, trace fine Gravel, trace fine root fibers, medium dense-very moist	96	18					
		17				80	20					
5		35			FILL: Red Brown Clayey fine to medium Sand, trace coarse Sand, medium dense-damp	97	8					
		19			ALLUVIUM: Light Brown fine Sand, trace to little Silt, loose to medium dense-damp	102	4					
10		13				97	4					
					Gray Brown Silty fine Sand, medium dense-damp							
15		19				101	8					
					Boring Terminated at 15'							

TBL 18G174.GPJ SOCALGEO.GDT 8/22/18





















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PROJECT: Proposed C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 15.5 feet
LOCATION: Ontario, California	LOGGED BY: Anthony Luna	READING TAKEN: At Completion

FIELD RESULTS				GRAPHIC LOG	DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	
					SURFACE ELEVATION: --- MSL							
					3± inches Manure <u>ALLUVIUM:</u> Light Gray Brown fine Sand, little Silt, loose-damp		5					
5		6					5					
		7					5					
		10			Gray Brown Silty fine Sand, loose to medium dense-damp		8					
		12			Gray Brown fine Sandy Silt, medium dense-damp to moist		11					
10												
		13			Gray Brown Clayey fine Sand, trace medium Sand, medium dense-moist		12					
15												
		36			Gray Brown Clayey Silt, trace fine Sand, trace Iron oxide staining, hard-moist		15					
20												
					Boring Terminated at 20'							

TBL 18G174.GPJ\_SOCALGEO.GDT 8/22/18



JOB NO.: 18G174	DRILLING DATE: 8/1/18	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 20 feet
LOCATION: Ontario, California	LOGGED BY: Anthony Luna	READING TAKEN: At Completion































FIELD RESULTS				GRAPHIC LOG	DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	
SURFACE ELEVATION: --- MSL												
					3± inches Manure							
		18			ALLUVIUM: Gray Brown fine Sand, trace Silt, medium dense-damp	91	4					
		14			Gray Brown Silty fine Sand, loose-moist	100	10					
5		14			Gray Brown Silty fine Sand to fine Sandy Silt, loose-very moist	92	22					
		20			Light Gray fine Sand, trace Silt, medium dense-damp	95	4					
10		20				93	4					
		16			Gray Brown Silty fine Sand, trace medium Sand, medium dense-moist		10					
15					Red Brown fine to medium Sand, trace fine Gravel, dense-damp		3					
20		48			Gray Brown Clayey Silt, trace fine Sand, very stiff-moist to very moist		19					
25		24	4.5+									
Boring Terminated at 25'												

TBL 18G174.GPJ\_SOCALGEO.GDT 8/22/18





JOB NO.: 18G174	DRILLING DATE: 8/1/18	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 28 feet
LOCATION: Ontario, California	LOGGED BY: Anthony Luna	READING TAKEN: At Completion

FIELD RESULTS				GRAPHIC LOG	DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	
SURFACE ELEVATION: --- MSL												
					5± inches Aggregate base							
					FILL: Gray Brown Silty fine Sand, medium dense-moist	85	14					
					ALLUVIUM: Gray Brown fine Sand, trace to little Silt, loose to medium dense-damp	97	3					
5		24				94	4					
		19				96	4					
		13				98	6					
		21			Gray Brown Silty fine Sand, trace medium Sand, trace Iron oxide staining, medium dense-damp							
10		19										
					Gray Brown Clayey fine Sand, some Silt, medium dense-moist		14					
15		27										
					Brown to Gray Brown Silty fine Sand, very dense-damp		8					
20		67										
					Gray Brown Clayey Silt, trace fine Sand, hard-very moist		22					
25		65	4.0									
					Gray Brown Silty Clay, trace calcareous nodules, medium stiff to stiff-very moist		27					
30		5	2.5									
		19	1.5			99	25					
					Brown fine Sandy Clay, very stiff-very moist							
35		35	4.0			108	21					
Boring Terminated at 35'												

TBL 18G174.GPJ, SOCALGEO.GDT 8/22/18



JOB NO.: 18G174	DRILLING DATE: 8/1/18	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 19 feet
LOCATION: Ontario, California	LOGGED BY: Anthony Luna	READING TAKEN: At Completion

FIELD RESULTS				GRAPHIC LOG	DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	
SURFACE ELEVATION: --- MSL												
5   												

TBL 18G174.GPJ SOCALGEO.GDT 8/22/18



JOB NO.: 18G174	DRILLING DATE: 8/1/18	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 10 feet
LOCATION: Ontario, California	LOGGED BY: Anthony Luna	READING TAKEN: At Completion

FIELD RESULTS				GRAPHIC LOG	DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	
SURFACE ELEVATION: --- MSL												
5   <												

TBL 18G174.GPJ SOCALGEO.GDT 8/22/18



JOB NO.: 18G174	DRILLING DATE: 8/1/18	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 16.5 feet
LOCATION: Ontario, California	LOGGED BY: Anthony Luna	READING TAKEN: At Completion

FIELD RESULTS				GRAPHIC LOG	DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	
SURFACE ELEVATION: --- MSL												
					3± inches Asphaltic concrete, 7± inches Aggregate base							
	X	17			FILL: Dark Gray Brown Silty fine to medium Sand, trace coarse Sand, trace fine Gravel, medium dense-moist to very moist		16					
	X	13			FILL: Dark Gray Brown fine Sandy Silt, medium dense-very moist		38					
5	X				ALLUVIUM: Light Gray Brown fine Sand, trace to little Silt, medium dense-damp							
	X	12					5					
	X	13					5					
10	X											
	X	14			Gray Silty fine Sand to fine Sandy Silt, medium dense-damp to moist		11					
15	X											
	X	18			Gray fine Sandy Silt, trace Clay, medium dense-very moist		18					
20	X											
Boring Terminated at 20'												

TBL 18G174.GPJ SOCALGEO.GDT 8/22/18



JOB NO.: 18G174	DRILLING DATE: 8/1/18	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 17 feet
LOCATION: Ontario, California	LOGGED BY: Anthony Luna	READING TAKEN: At Completion

FIELD RESULTS				GRAPHIC LOG	DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	
SURFACE ELEVATION: --- MSL												
5   <												

TBL 18G174.GPJ\_SOCALGEO.GDT 8/22/18



JOB NO.: 18G174	DRILLING DATE: 8/1/18	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 9 feet
LOCATION: Ontario, California	LOGGED BY: Anthony Luna	READING TAKEN: At Completion




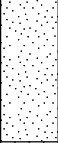




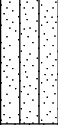





FIELD RESULTS				DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)		DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)	
				SURFACE ELEVATION: --- MSL							
5	X	12		3± inches Asphaltic concrete, 7± inches Aggregate base		27					No Sample Recovered
	X	22		FILL: Black Silty fine Sand to fine Sandy Silt, trace Clay, medium dense-very moist							
	X	16		ALLUVIUM: Brown Silty fine Sand, medium dense-damp		6					
	X	12				8					
10	X										
15	X	12		Gray Brown Silty fine Sand to fine Sandy Silt, trace calcareous nodules, medium dense-moist		13					
				Boring Terminated at 15'							

TBL 18G174.GPJ SOCALGEO.GDT 8/22/18





JOB NO.: 18G174	DRILLING DATE: 8/1/18	WATER DEPTH: Dry
PROJECT: Proposed C/I Development	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: 17 feet
LOCATION: Ontario, California	LOGGED BY: Anthony Luna	READING TAKEN: At Completion

FIELD RESULTS				GRAPHIC LOG	DESCRIPTION	LABORATORY RESULTS						COMMENTS	
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	ORGANIC CONTENT (%)		
SURFACE ELEVATION: --- MSL													
5		25			5± inches Aggregate base	112	16					El = 2 @ 0 to 5'	
		32			<u>FILL:</u> Gray Brown Silty Clay, little fine to coarse Sand, little fine Gravel, trace Asphaltic concrete fragments, very stiff-moist to very moist	110	3						
		16				102	3						
		23			Light Gray fine Sandy Silt, medium dense-damp	94	6						
		18			Light Gray Brown Silty fine Sand, medium dense-dry	98	2						
15		17			Gray Brown fine Sandy Silt, trace calcareous veining, medium dense-moist		13						
		13		1.5			Gray Clayey Silt, trace Iron oxide staining, stiff to very stiff-very moist						26
		18		4.0									32
25					Boring Terminated at 25'								

TBL 18G174.GPJ, SOCALGEO.GDT 8/22/18



JOB NO.: 18G174		DRILLING DATE: 8/1/18		WATER DEPTH: Dry								
PROJECT: Proposed C/I Development		DRILLING METHOD: Hollow Stem Auger		CAVE DEPTH: 23 feet								
LOCATION: Ontario, California		LOGGED BY: Anthony Luna		READING TAKEN: At Completion								
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 (%)	ORGANIC CONTENT (%)	COMMENTS
SURFACE ELEVATION: --- MSL												
					FILL: Light Gray Brown fine Sand, little Silt, trace to little medium Sand, medium dense-damp	99	7					
					FILL: Gray Brown Silty fine Sand, slightly mottled, loose-damp	99	5					
5					ALLUVIUM: Light Brown Silty fine Sand, medium dense to dense-damp	113	9					
						99	4					
10						94	4					
					Light Brown fine Sand, trace Silt, medium dense-damp		6					
15												
					Light Gray Brown fine Sandy Silt to Silty fine Sand, medium dense-moist		14					
20												
					Gray Brown Clayey Silt, stiff to very stiff-moist to very moist		19					
25												
							16					
30												
Boring Terminated at 30'												

BL 18G174.GPJ SOCALGEO.GDT 8/22/18

# SOUTHERN CALIFORNIA GEOTECHNICAL

**TRENCH NO.  
T-2**

JOB NO.: 18G174-1

EQUIPMENT USED: Backhoe

WATER DEPTH: Dry

PROJECT: Proposed Commercial/Industrial Development

LOGGED BY: Scott McCann

SEEPAGE DEPTH: Dry

LOCATION: Ontario, California

ORIENTATION: N 8 W

READINGS TAKEN: At Completion

DATE: 8-2-2018

TOP OF TRENCH ELEVATION: ---- feet msl

DEPTH	SAMPLE	MOISTURE (%)	ORGANIC CONTENT (%)	EARTH MATERIALS DESCRIPTION	GRAPHIC REPRESENTATION
	b	11	69	A: 3 inches Manure	
	b	3	2	B: ALLUVIUM: Dark Gray Brown Silty fine Sand to fine Sandy Silt, trace organics, medium dense - moist	
	b	4	1	C: ALLUVIUM: Light Gray Brown fine Sand, trace medium Sand, medium dense - damp	
				D: ALLUVIUM: Light Gray Brown Silty fine Sand, loose to medium dense - damp	
5	b	6		Trench Terminated @ 5 feet	
10					
15					

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-3**

JOB NO.: 18G174-1

EQUIPMENT USED: Backhoe

WATER DEPTH: Dry

PROJECT: Proposed Commercial/Industrial Development

LOGGED BY: Scott McCann

SEEPAGE DEPTH: Dry

LOCATION: Ontario, California

ORIENTATION: N 86 W

READINGS TAKEN: At Completion

DATE: 8-2-2018

TOP OF TRENCH ELEVATION: ---- feet msl

DEPTH	SAMPLE	MOISTURE (%)	ORGANIC CONTENT (%)	EARTH MATERIALS DESCRIPTION	GRAPHIC REPRESENTATION
	b	4		A: ALLUVIUM: Light Gray Brown fine Sand, trace Silt, trace medium Sand, trace fine root fibers, medium dense - damp	
				B: ALLUVIUM: Light Gray Brown fine Sand, little Silt, loose to medium dense - damp to moist	
5	b	6			
	b	25		C: ALLUVIUM: Gray fine Sandy Silt, medium dense - very moist	
	b	22			
10	b	4		D: ALLUVIUM: Gray Brown fine to medium Sand, trace fine Gravel, medium dense - damp	
				Trench Terminated @ 10 feet	
15					

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-4**

JOB NO.: 18G174-1

EQUIPMENT USED: Backhoe

WATER DEPTH: Dry

PROJECT: Proposed Commercial/Industrial Development

LOGGED BY: Scott McCann

SEEPAGE DEPTH: Dry

LOCATION: Ontario, California

ORIENTATION: N 7 W

DATE: 8-2-2018

TOP OF TRENCH ELEVATION: ---- feet msl

READINGS TAKEN: At Completion

DEPTH	SAMPLE	MOISTURE (%)	ORGANIC CONTENT (%)	EARTH MATERIALS DESCRIPTION	GRAPHIC REPRESENTATION
					<p>N 7 W →</p> <p>SCALE: 1" = 5'</p>
	b	18		A: ALLUVIUM: Gray Brown fine Sand, trace to little Silt, loose - very moist	
	b	9		B: ALLUVIUM: Light Gray Brown fine Sand, trace medium Sand, trace Silt, loose to medium dense - damp/moist	
5				C: ALLUVIUM: Light Gray Brown Silty fine Sand, medium dense - moist	
	b	13			
10	b	9		D: ALLUVIUM: Gray Brown fine Sand, trace medium Sand, trace fine Gravel, medium dense - damp	
				Trench Terminated @ 10 feet	
15					

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-1**

JOB NO.: 18G174-1

EQUIPMENT USED: Backhoe

WATER DEPTH: Dry

PROJECT: Proposed Commercial/Industrial Development

LOGGED BY: Scott McCann

SEEPAGE DEPTH: Dry

LOCATION: Ontario, California

ORIENTATION: N 4 E

READINGS TAKEN: At Completion

DATE: 8-2-2018

TOP OF TRENCH ELEVATION: ---- feet msl

DEPTH	SAMPLE	MOISTURE (%)	ORGANIC CONTENT (%)	EARTH MATERIALS DESCRIPTION	GRAPHIC REPRESENTATION
	b		12	A: 3 inches Manure	<p>N 4 E</p> <p>SCALE: 1" = 5'</p>
	b	13	2	B: ALLUVIUM: Dark Gray Brown Silty fine Sand to fine Sandy Silt, trace organics, medium dense - moist	
	b	10	5		
	b	4	1	C: ALLUVIUM: Light Gray Brown Silty fine Sand, trace medium Sand, medium dense - damp	
5	b	4		Trench Terminated @ 5 feet	
10					
15					

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

**TRENCH LOG**

**PLATE B-13**



# SOUTHERN CALIFORNIA GEOTECHNICAL

**TRENCH NO.  
T-5**

JOB NO.: 18G174-1

EQUIPMENT USED: Excavator

PERCHED WATER DEPTH: 5 feet

PROJECT: Proposed Commercial/Industrial Development

LOGGED BY: Scott McCann

SEEPAGE DEPTH: 5 feet

LOCATION: Ontario, California

ORIENTATION: N 13 E

READINGS TAKEN: At Completion

DATE: 8-2-2018

TOP OF TRENCH ELEVATION: ----- feet msl

DEPTH	SAMPLE	MOISTURE (%)	ORGANIC CONTENT (%)	EARTH MATERIALS DESCRIPTION	GRAPHIC REPRESENTATION
5	b	8		A: ALLUVIUM: Gray Brown Silty fine to medium Sand, trace fine root fibers, loose to medium dense - damp	<p>N 13 E</p> <p>SCALE: 1" = 5'</p>
	b	3		B: ALLUVIUM: Light Gray Brown fine Sand, trace medium Sand, trace Silt, medium dense - dry to damp	
	b	16		C: ALLUVIUM: Brown fine Sandy Silt, medium dense - moist	
				Trench Terminated @ 5 feet	

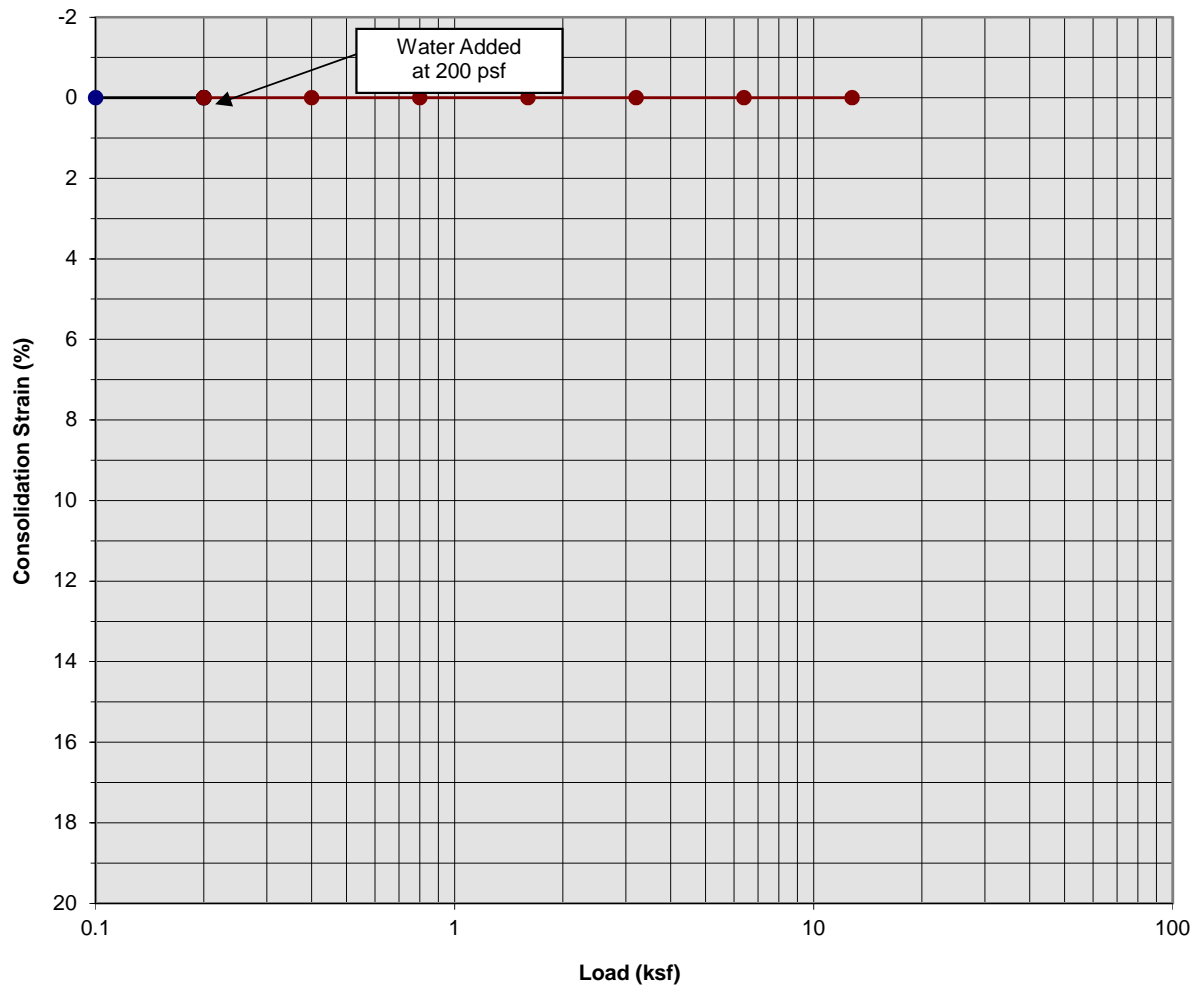
KEY TO SAMPLE TYPES:  
B - BULK SAMPLE (DISTURBED)  
R - RING SAMPLE 2-1/2" DIAMETER  
(RELATIVELY UNDISTURBED)

**TRENCH LOG**

**PLATE B-17**

# APPENDIX

### Consolidation/Collapse Test Results



### Classification:

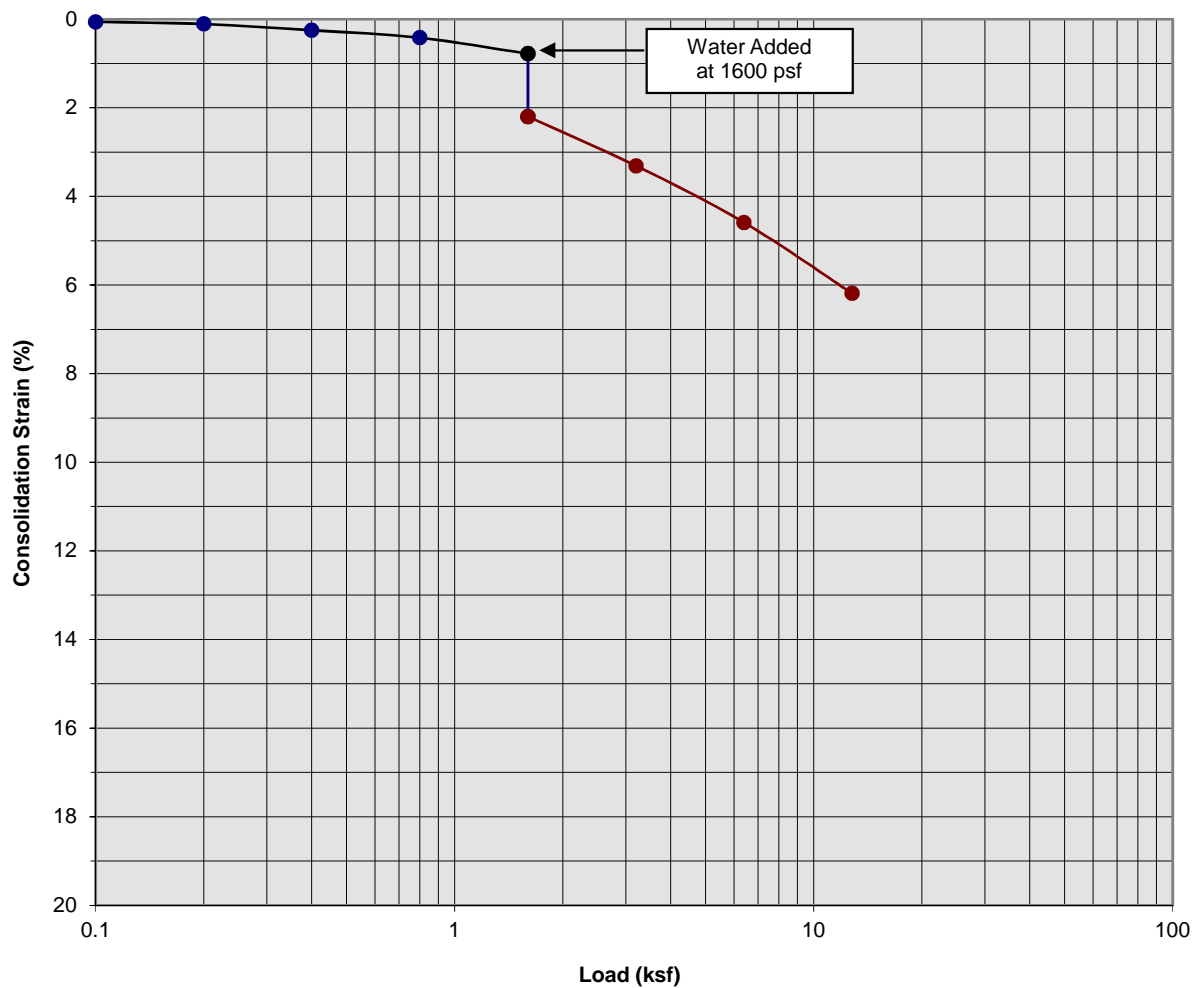
Boring Number:	0	Initial Moisture Content (%)	#DIV/0!
Sample Number:	---	Final Moisture Content (%)	#DIV/0!
Depth (ft)	0	Initial Dry Density (pcf)	#DIV/0!
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	#DIV/0!
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.00

Project No.  
**PLATE C- 15**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation

### Consolidation/Collapse Test Results



Classification: Gray Brown fine Sand, some Silt

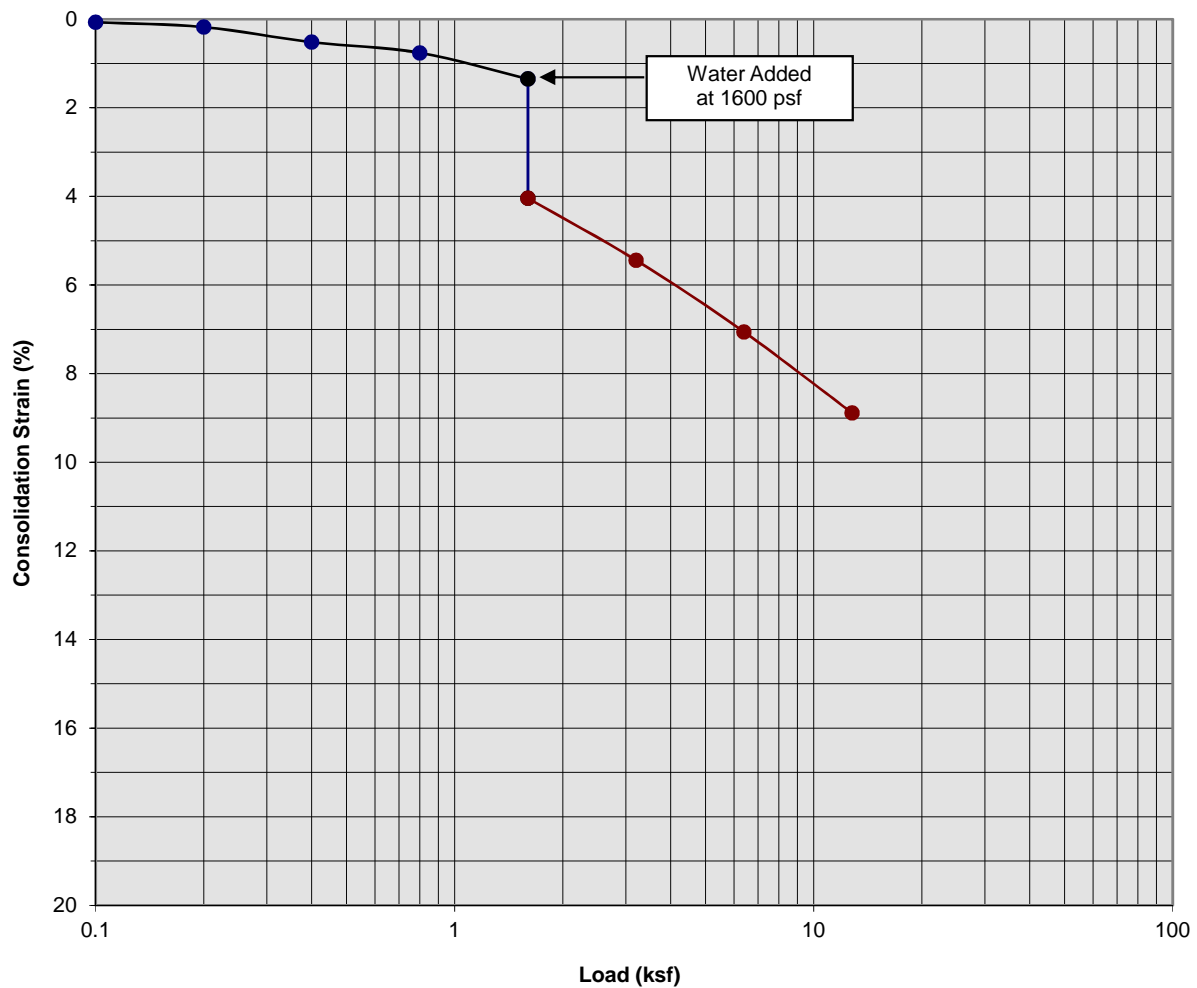
Boring Number:	B-1	Initial Moisture Content (%)	6
Sample Number:	---	Final Moisture Content (%)	12
Depth (ft)	3 to 4	Initial Dry Density (pcf)	95.2
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	101.6
Specimen Thickness (in)	1.0	Percent Collapse (%)	1.42

Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C- 1**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation

### Consolidation/Collapse Test Results



Classification: Gray Brown fine Sand, some Silt

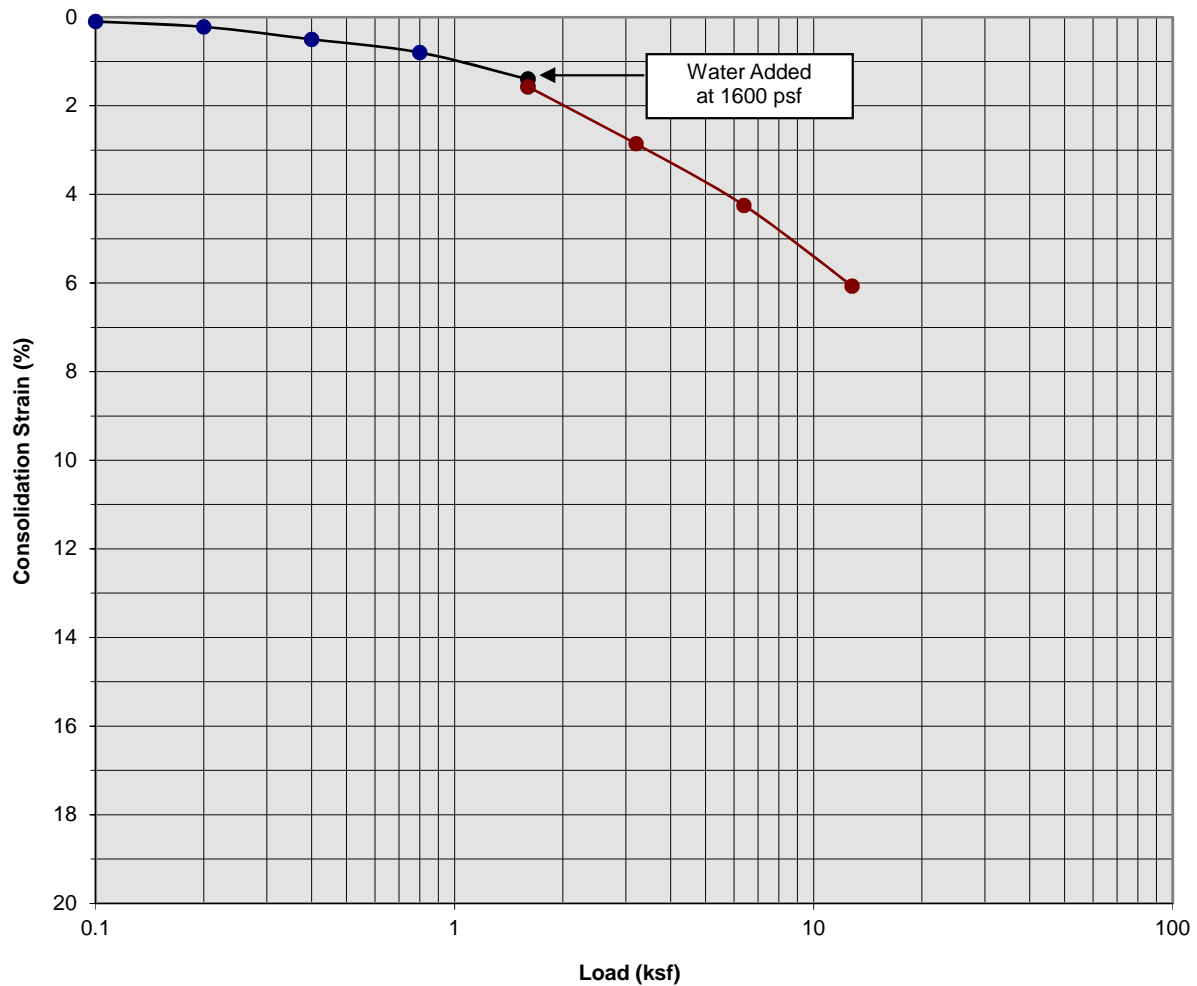
Boring Number:	B-1	Initial Moisture Content (%)	5
Sample Number:	---	Final Moisture Content (%)	17
Depth (ft)	5 to 6	Initial Dry Density (pcf)	96.6
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	106.2
Specimen Thickness (in)	1.0	Percent Collapse (%)	2.69

Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C- 2**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation

### Consolidation/Collapse Test Results



Classification: Gray Brown fine Sand, some Silt

Boring Number:	B-1	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	21
Depth (ft)	7 to 8	Initial Dry Density (pcf)	96.9
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	103.3
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.17

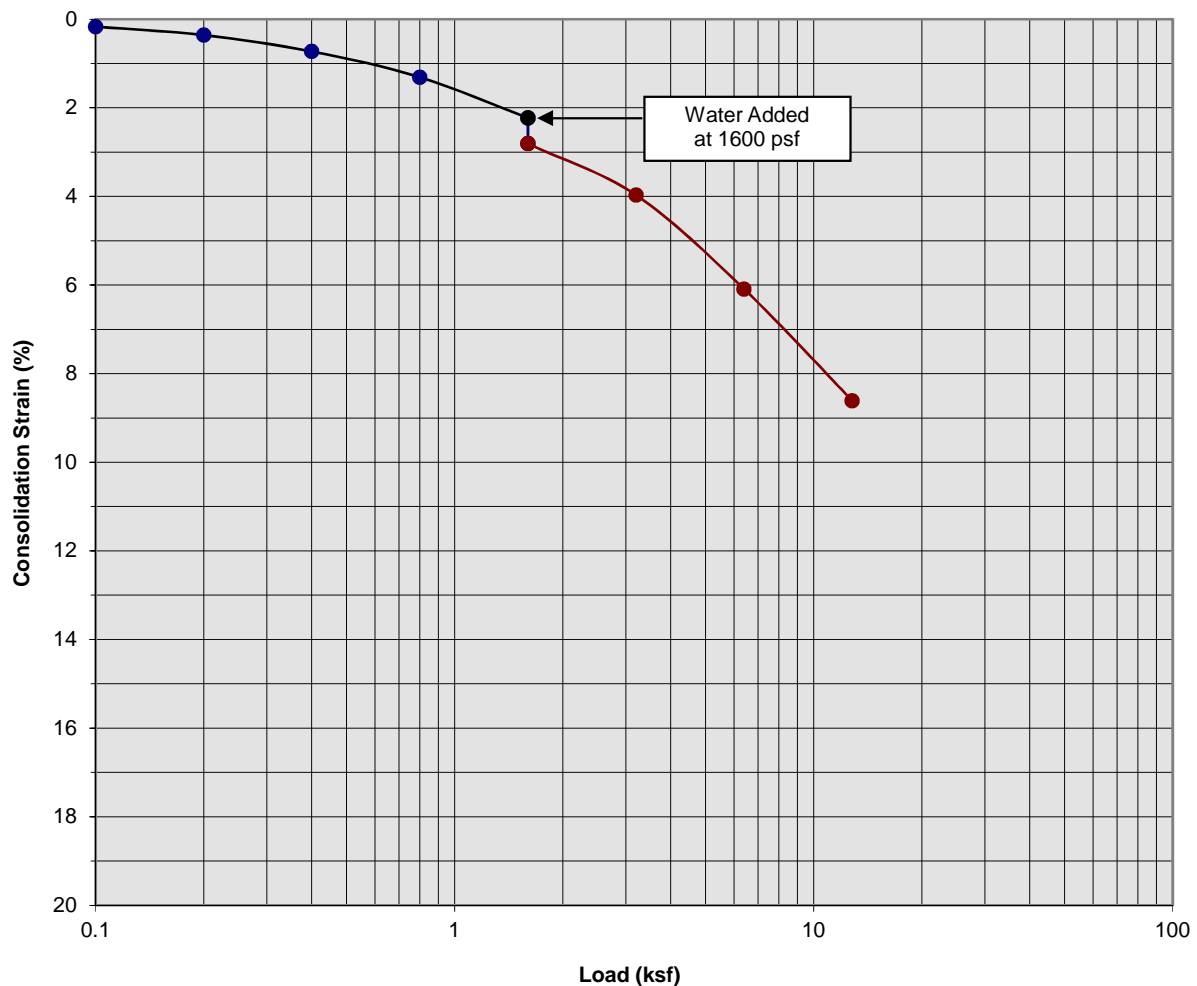
Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C- 3**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation



### Consolidation/Collapse Test Results



Classification: FILL: Gray Brown Silty fine Sand

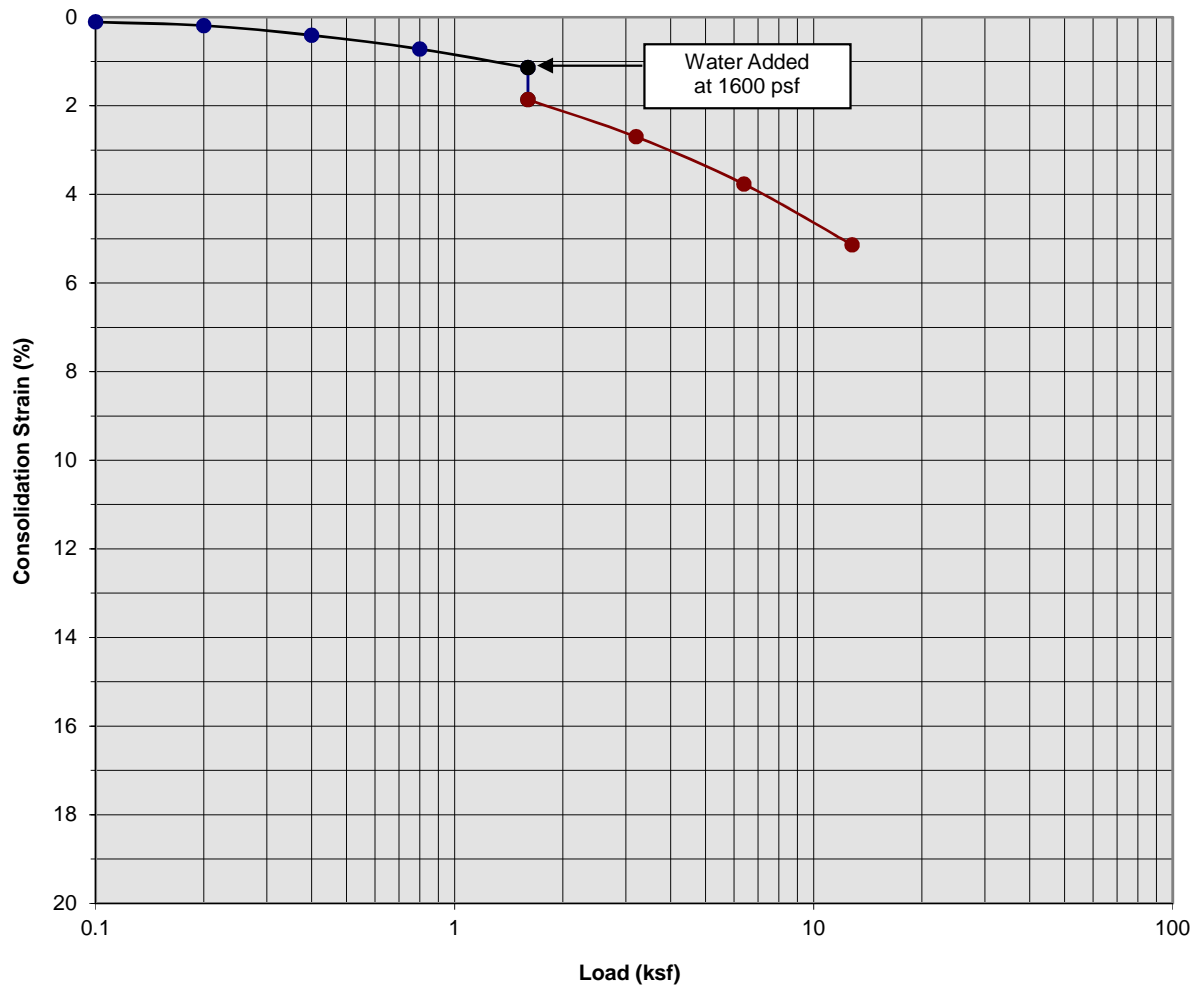
Boring Number:	B-5	Initial Moisture Content (%)	14
Sample Number:	---	Final Moisture Content (%)	26
Depth (ft)	1 to 2	Initial Dry Density (pcf)	85.1
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	93.5
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.58

Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C- 4**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation

### Consolidation/Collapse Test Results



Classification: Gray Brown fine Sand, trace to little Silt

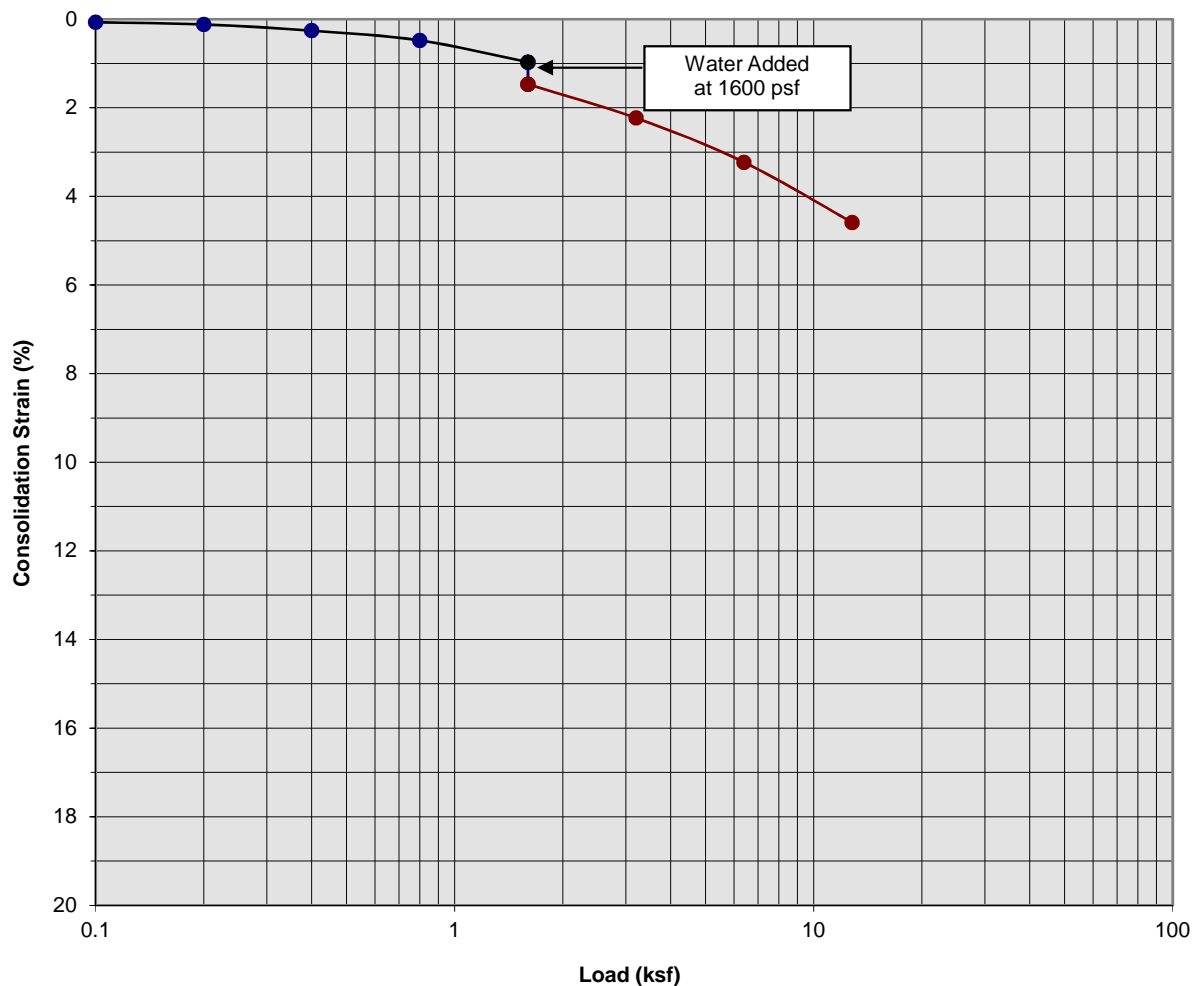
Boring Number:	B-5	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	20
Depth (ft)	3 to 4	Initial Dry Density (pcf)	97.2
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	109.3
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.72

Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C- 5**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation

### Consolidation/Collapse Test Results



Classification: Gray Brown fine Sand, trace to little Silt

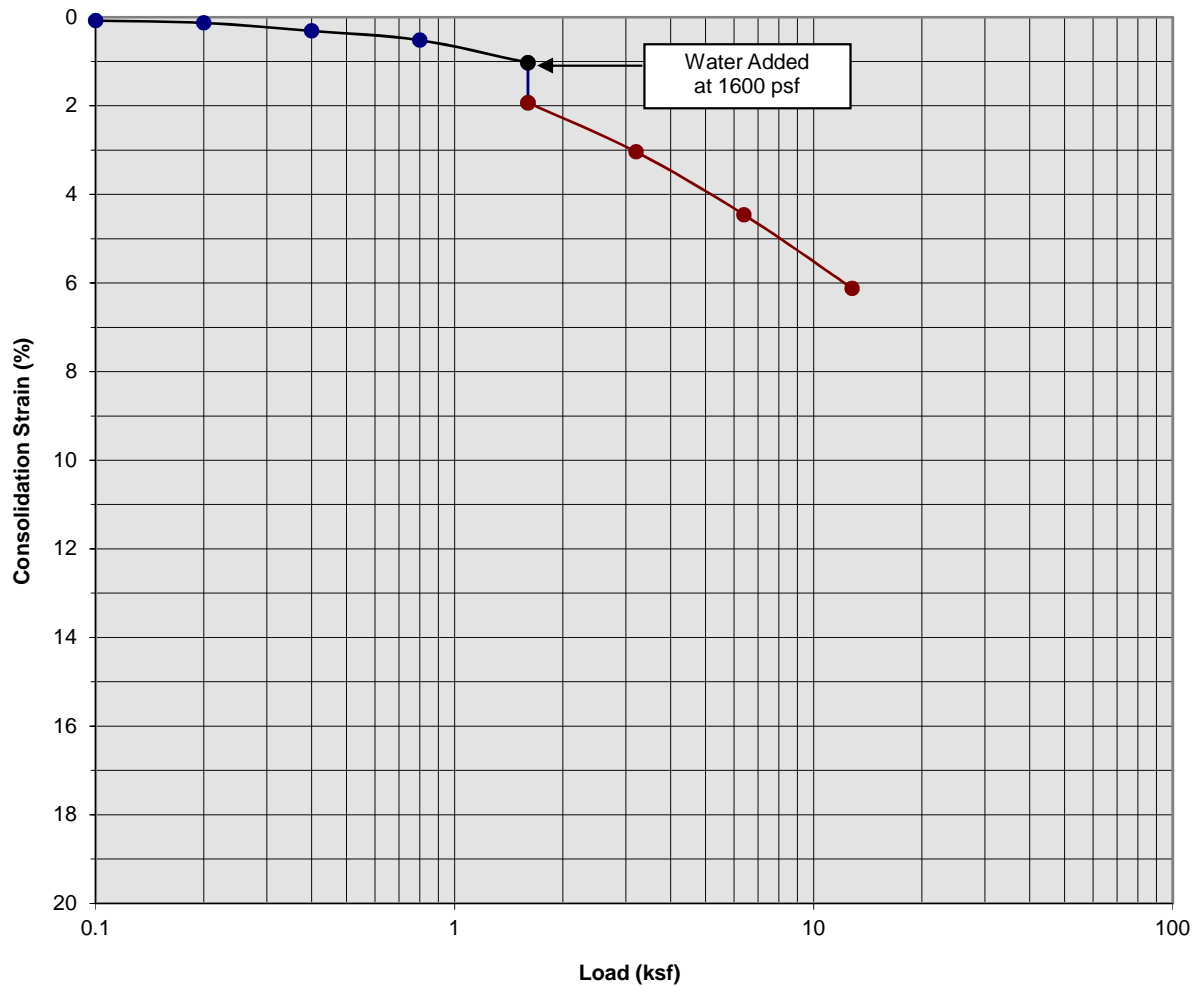
Boring Number:	B-5	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	23
Depth (ft)	5 to 6	Initial Dry Density (pcf)	94.9
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	98.9
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.50

Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C- 6**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation

### Consolidation/Collapse Test Results



Classification: Gray Brown fine Sand, trace to little Silt

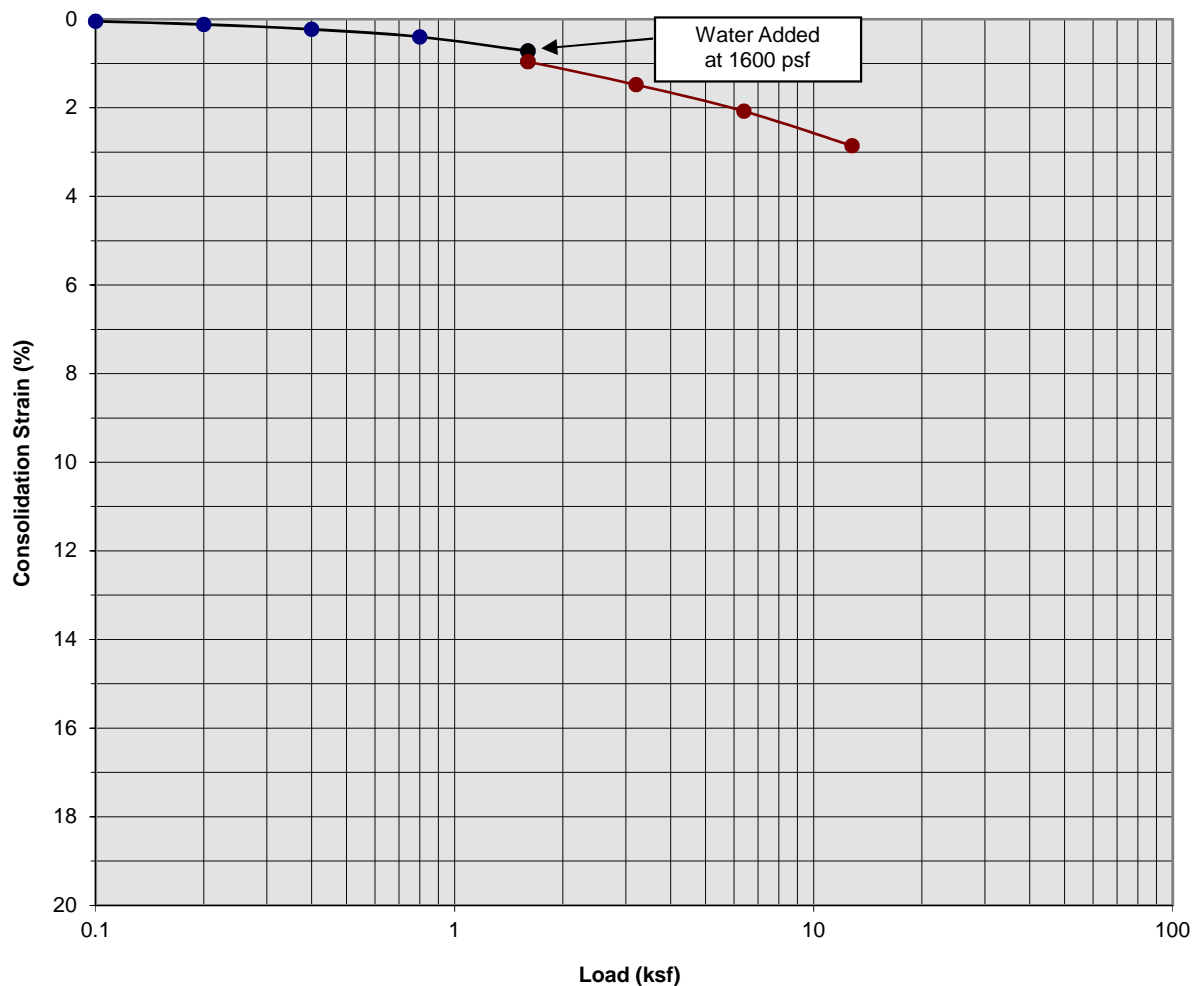
Boring Number:	B-5	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	21
Depth (ft)	7 to 8	Initial Dry Density (pcf)	96.0
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	102.1
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.90

Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C- 7**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation

### Consolidation/Collapse Test Results



Classification: FILL: Light Brown Silty fine Sand

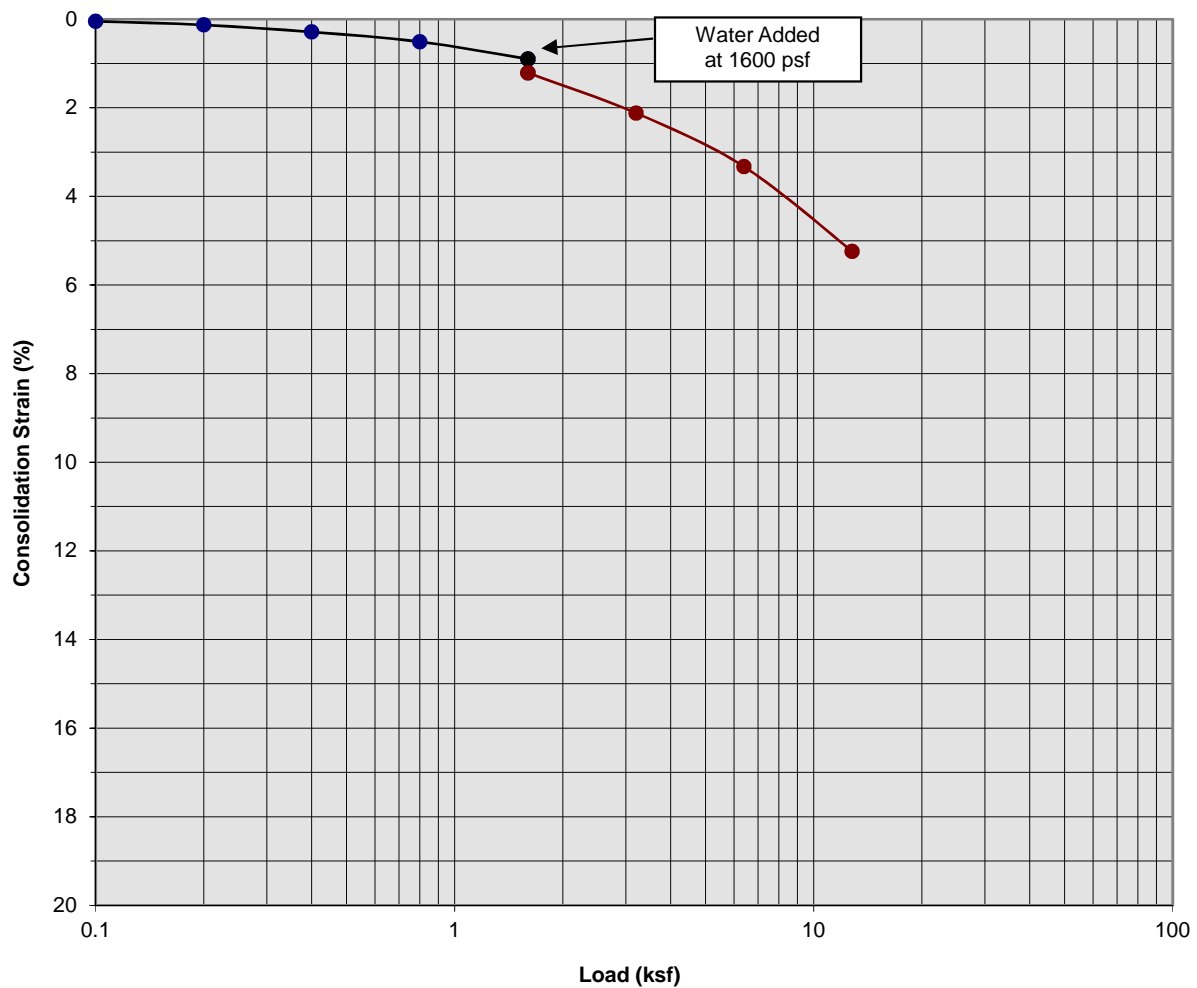
Boring Number:	B-9	Initial Moisture Content (%)	4
Sample Number:	---	Final Moisture Content (%)	16
Depth (ft)	1 to 2	Initial Dry Density (pcf)	104.3
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	107.2
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.24

Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C- 8**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation

### Consolidation/Collapse Test Results



Classification: Light Brown Silty fine Sand

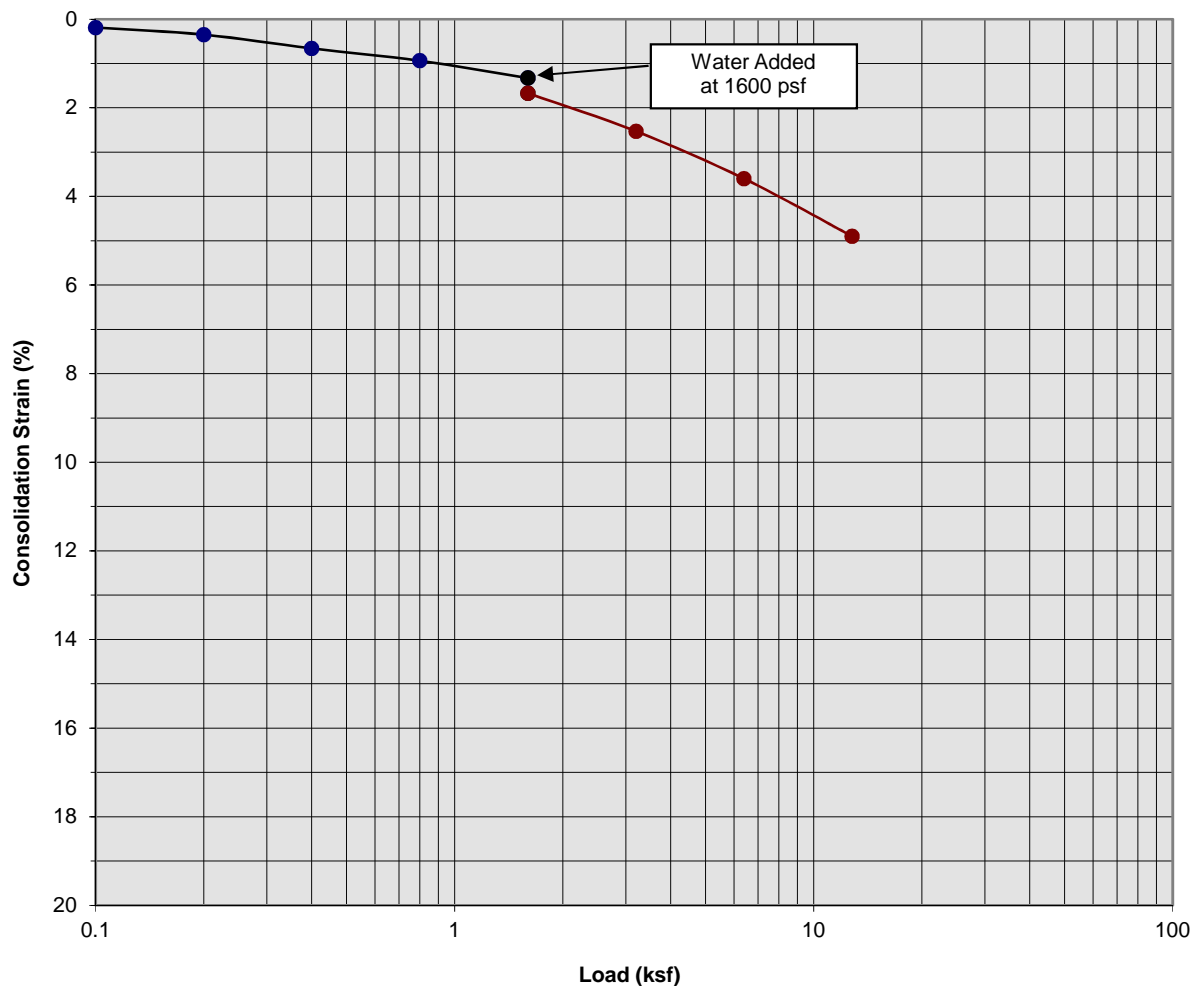
Boring Number:	B-9	Initial Moisture Content (%)	12
Sample Number:	---	Final Moisture Content (%)	25
Depth (ft)	3 to 4	Initial Dry Density (pcf)	89.6
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	94.4
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.31

Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C- 9**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation

### Consolidation/Collapse Test Results



Classification: Light Gray Brown fine to medium Sand

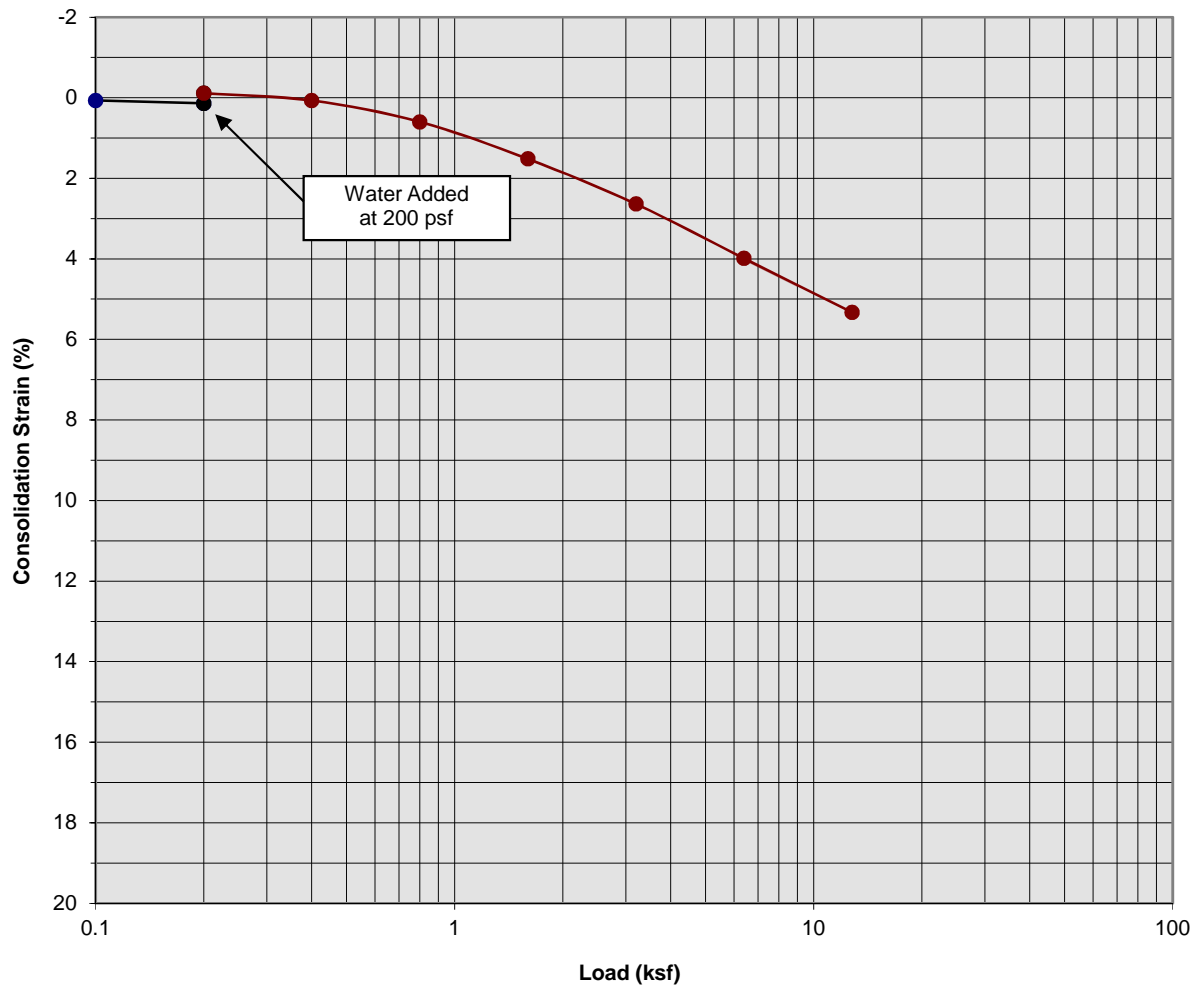
Boring Number:	B-9	Initial Moisture Content (%)	3
Sample Number:	---	Final Moisture Content (%)	19
Depth (ft)	7 to 8	Initial Dry Density (pcf)	105.2
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	110.7
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.34

Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C- 10**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation

### Consolidation/Collapse Test Results



Classification: FILL: Gray Brown Silty Clay, little fine to coarse Sand, little fine Gravel

Boring Number:	B-11	Initial Moisture Content (%)	16
Sample Number:	---	Final Moisture Content (%)	18
Depth (ft)	1 to 2	Initial Dry Density (pcf)	112.3
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	118.9
Specimen Thickness (in)	1.0	Percent Collapse (%)	-0.25

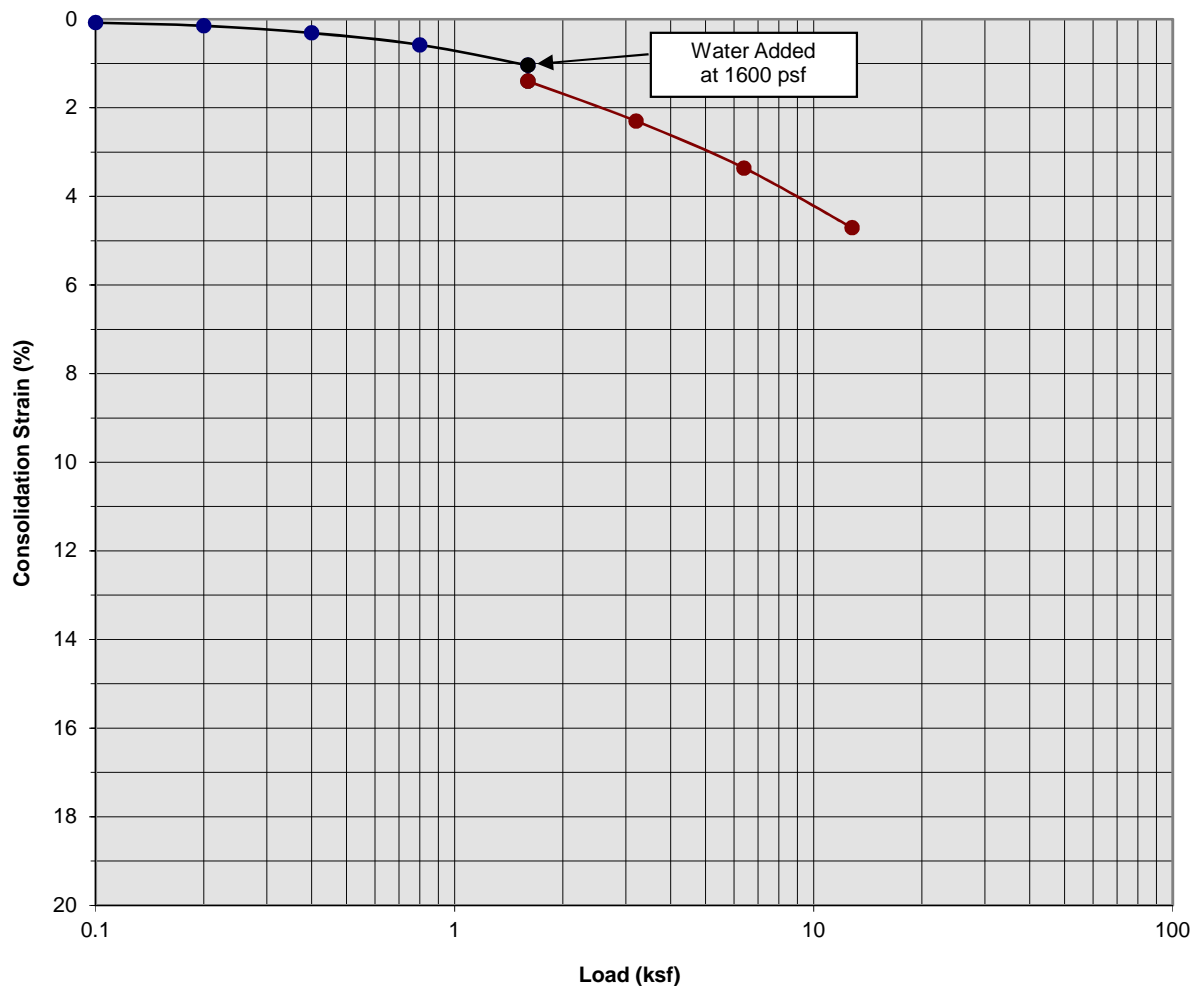
Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C- 11**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation



### Consolidation/Collapse Test Results



Classification: Light Gray fine Sand, trace Silt

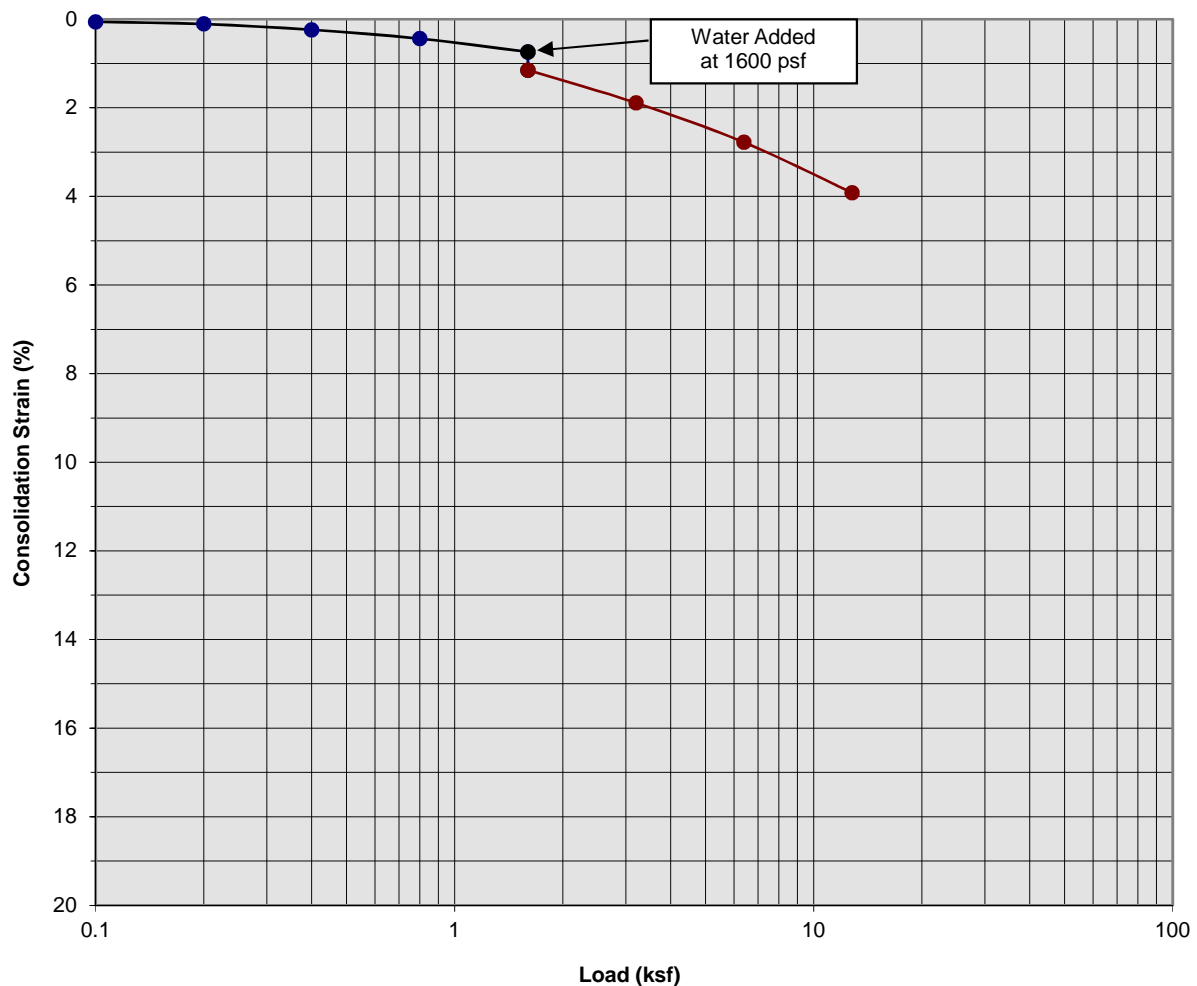
Boring Number:	B-11	Initial Moisture Content (%)	3
Sample Number:	---	Final Moisture Content (%)	12
Depth (ft)	3 to 4	Initial Dry Density (pcf)	110.1
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	115.4
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.36

Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C- 12**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation

### Consolidation/Collapse Test Results



Classification: Light Gray fine Sand, trace Silt

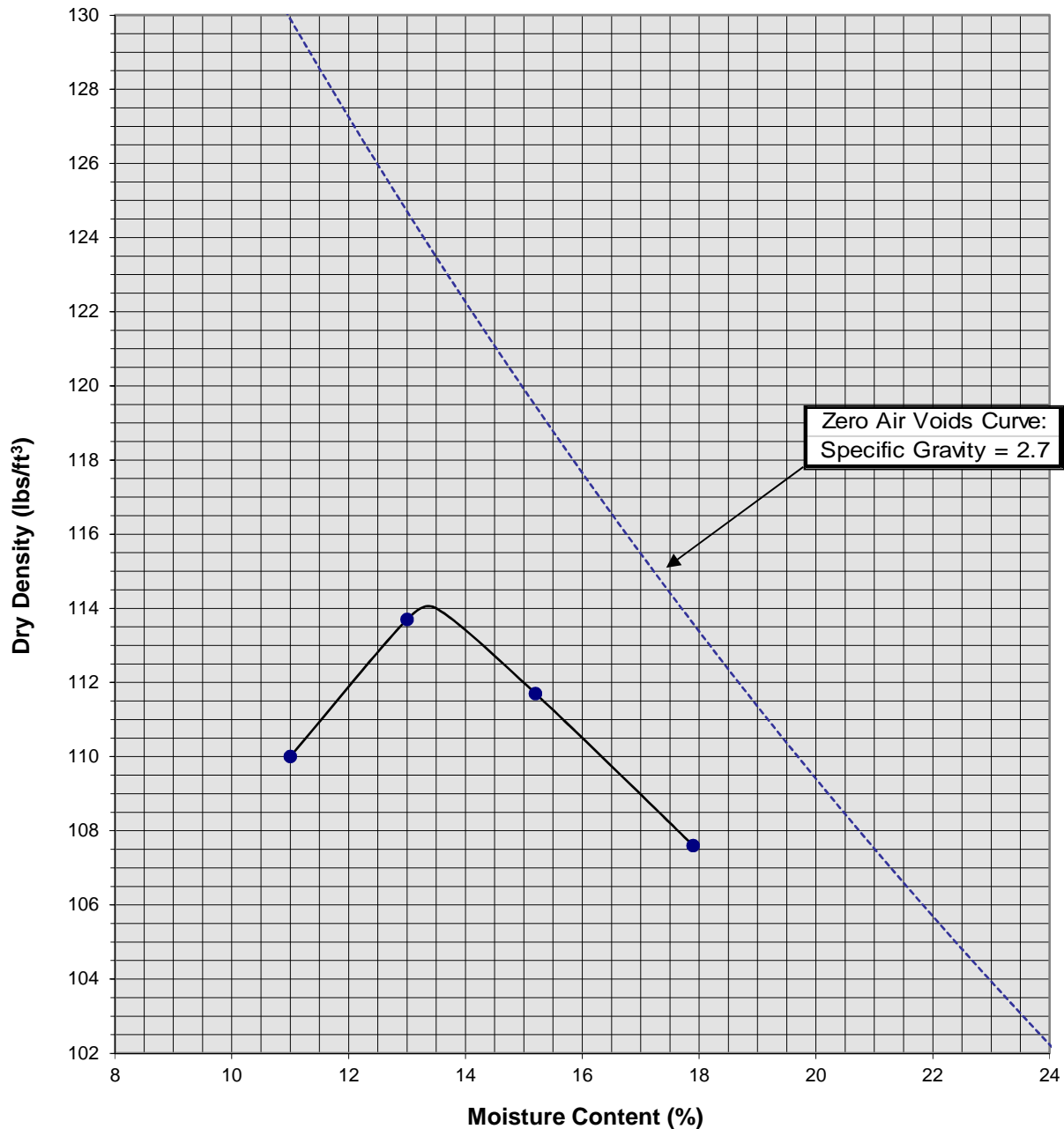
Boring Number:	B-11	Initial Moisture Content (%)	3
Sample Number:	---	Final Moisture Content (%)	13
Depth (ft)	5 to 6	Initial Dry Density (pcf)	101.7
Specimen Diameter (in)	2.4	Final Dry Density (pcf)	105.7
Specimen Thickness (in)	1.0	Percent Collapse (%)	0.41

Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C- 13**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation

# Moisture/Density Relationship ASTM D-1557



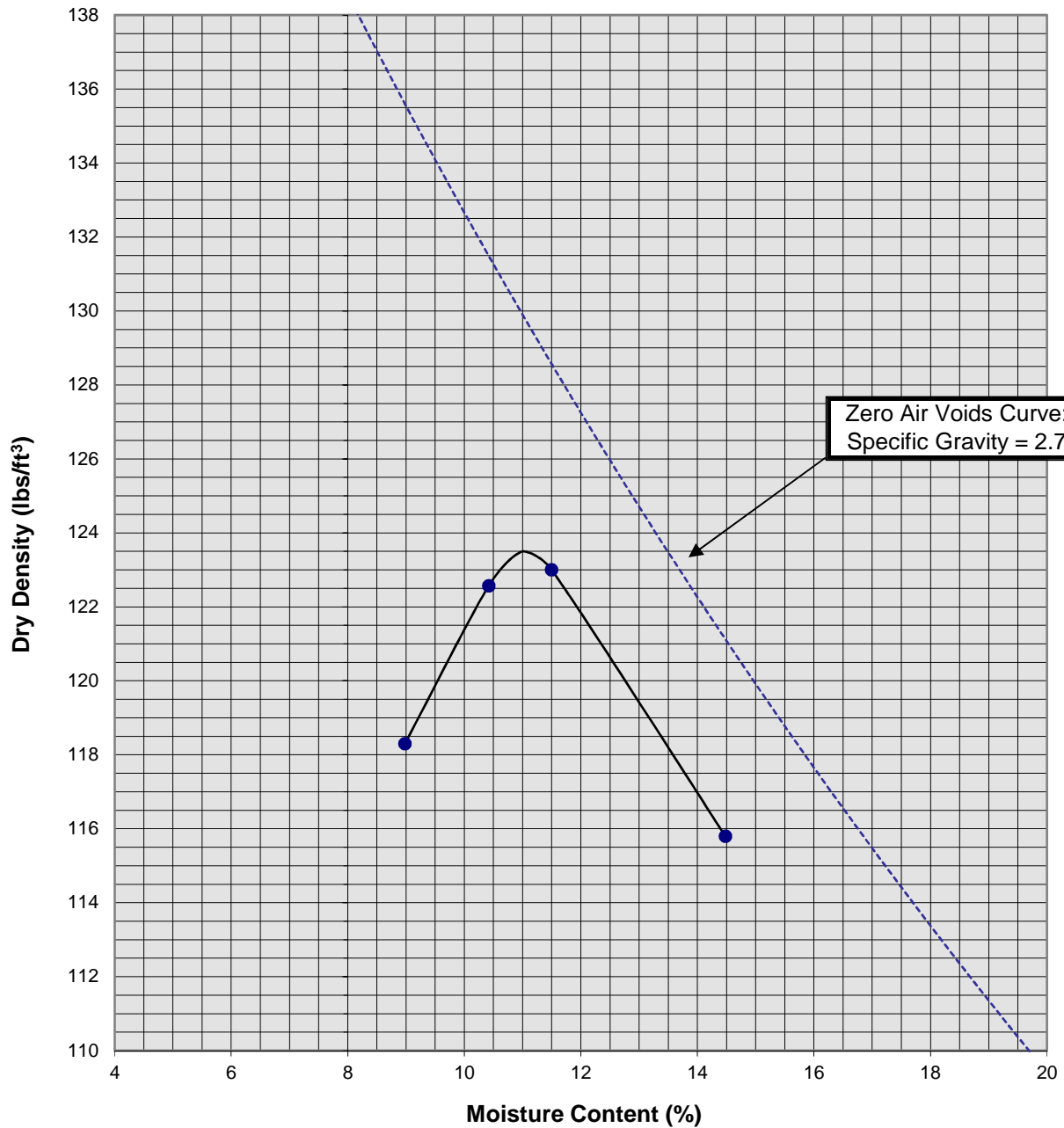
Soil ID Number	B-2 @ 0 to 5'
Optimum Moisture (%)	13.5
Maximum Dry Density (pcf)	114
Soil Classification	Dark Gray Brown Silty fine Sand, trace medium to coarse Sand, trace fine Gravel

Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C-14**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
A California Corporation

# Moisture/Density Relationship ASTM D-1557



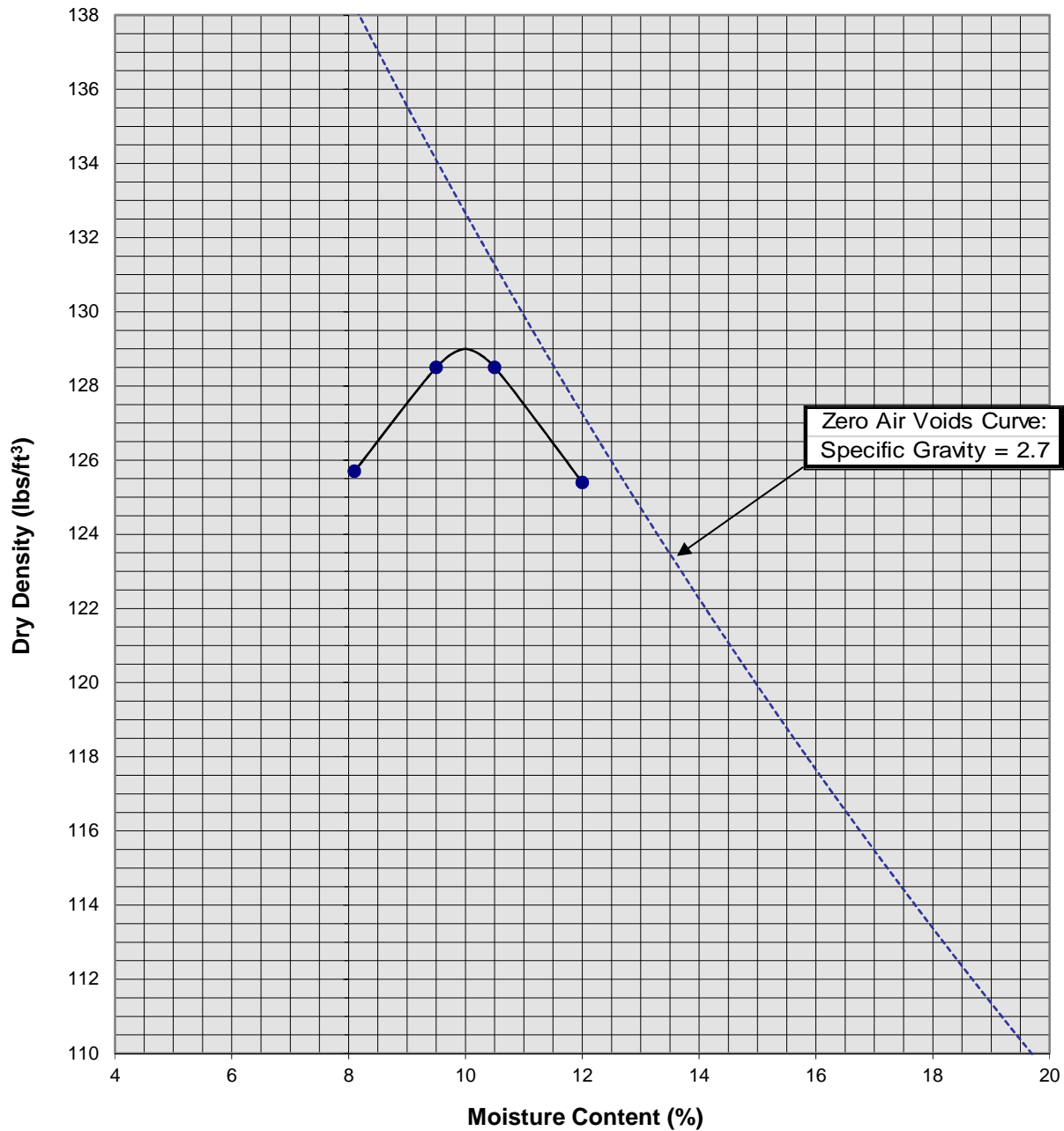
Soil ID Number	B-4 @ 0 to 5'
Optimum Moisture (%)	11
Maximum Dry Density (pcf)	123.5
Soil Classification	Gray Brown Silty fine Sand to fine Sandy Silt

Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C-15**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
*A California Corporation*

# Moisture/Density Relationship ASTM D-1557



Soil ID Number	B-11 @ 0 to 5'
Optimum Moisture (%)	10
Maximum Dry Density (pcf)	129
Soil Classification	Gray Brown Silty fine to coarse Sand, some Clay, trace fine Gravel

Proposed C/I Development  
Ontario, California  
Project No. 18G174  
**PLATE C-16**



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**  
*A California Corporation*

# APPENDIX

## **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

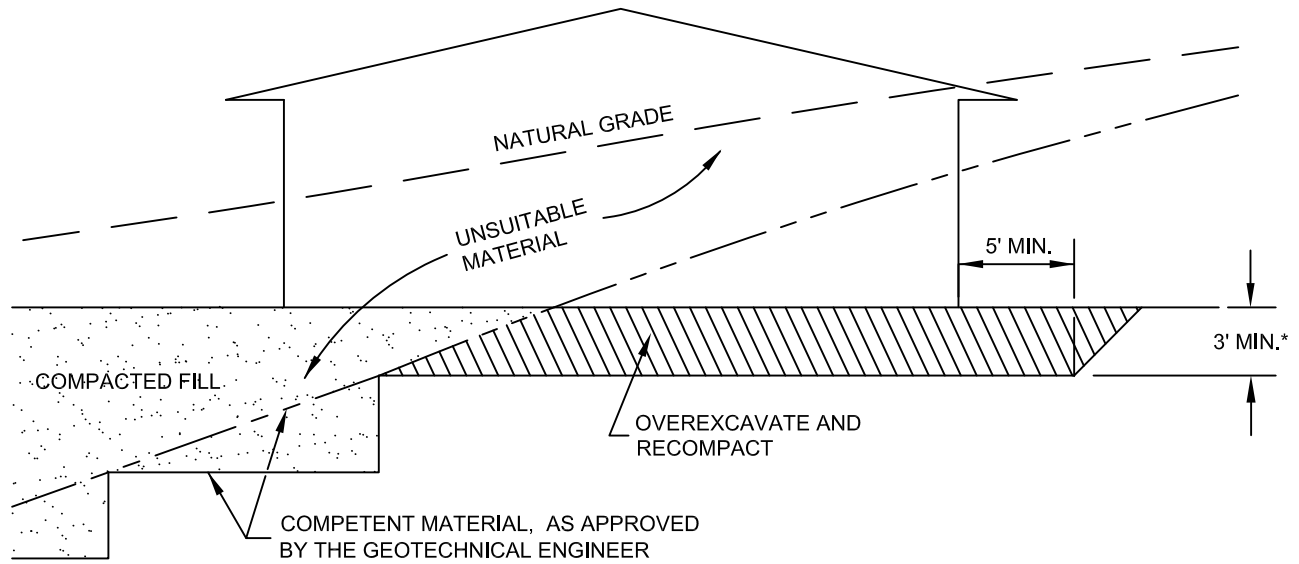
- All cut slopes should be inspected by the Geotechnical Engineer to determine the need for stabilization. The Earthwork Contractor should notify the Geotechnical Engineer when slope cutting is in progress at intervals of 10 vertical feet. Failure to notify may result in a delay in recommendations.
-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

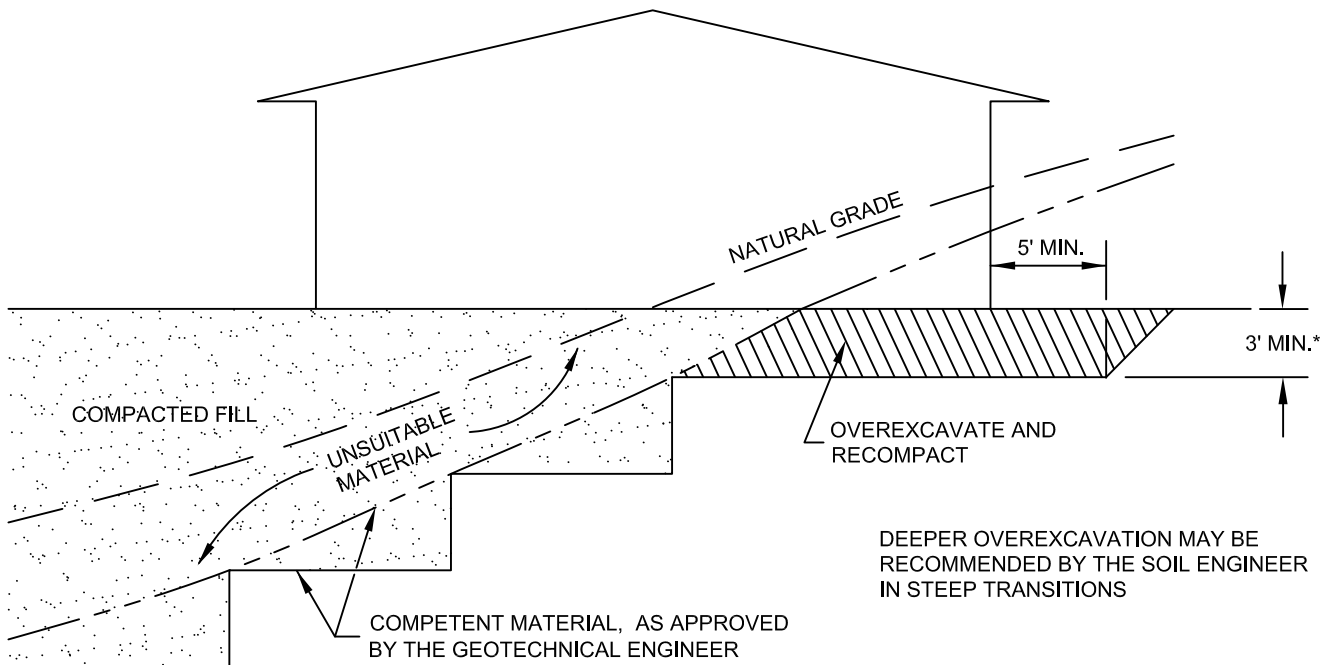
#### Subdrains

- 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  $\frac{3}{4}$ -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)



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

#### TRANSITION LOT DETAIL

#### GRADING GUIDE SPECIFICATIONS

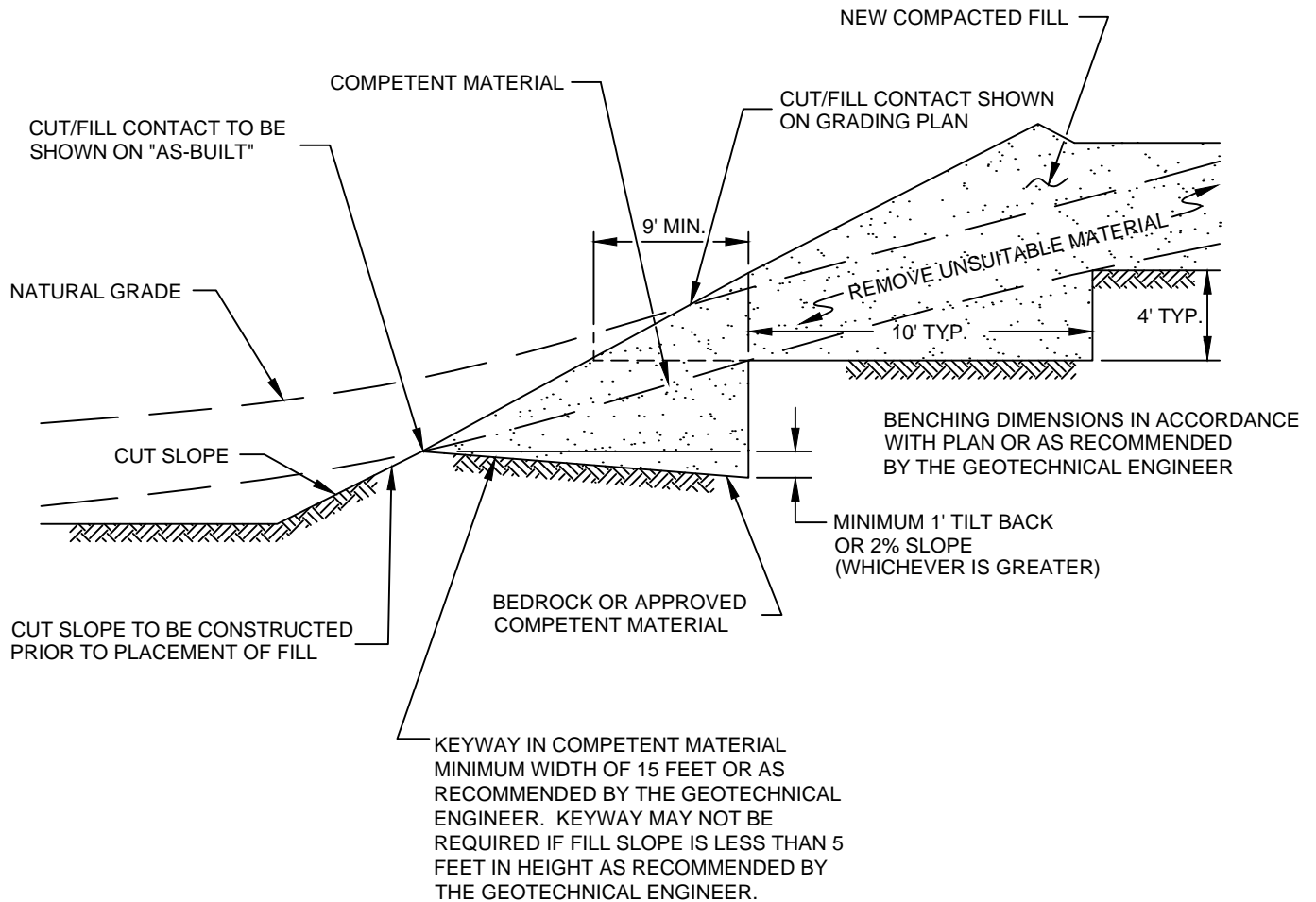
NOT TO SCALE

DRAWN: JAS  
CHKD: GKM

PLATE D-1



**SOUTHERN  
CALIFORNIA  
GEOTECHNICAL**



**FILL ABOVE CUT SLOPE DETAIL**  
**GRADING GUIDE SPECIFICATIONS**

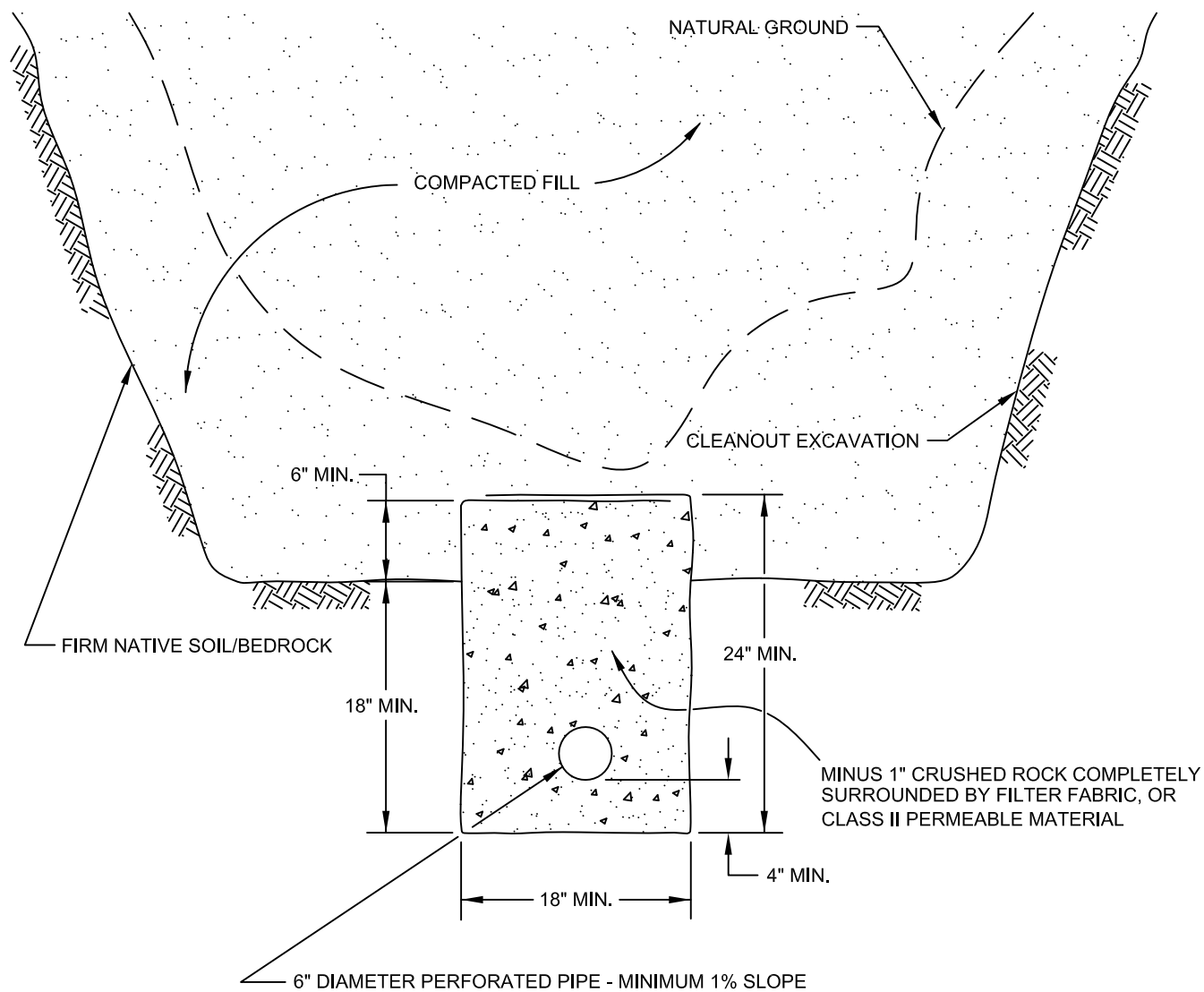
NOT TO SCALE

DRAWN: JAS  
 CHKD: GKM

PLATE D-2




**SOUTHERN  
 CALIFORNIA  
 GEOTECHNICAL**

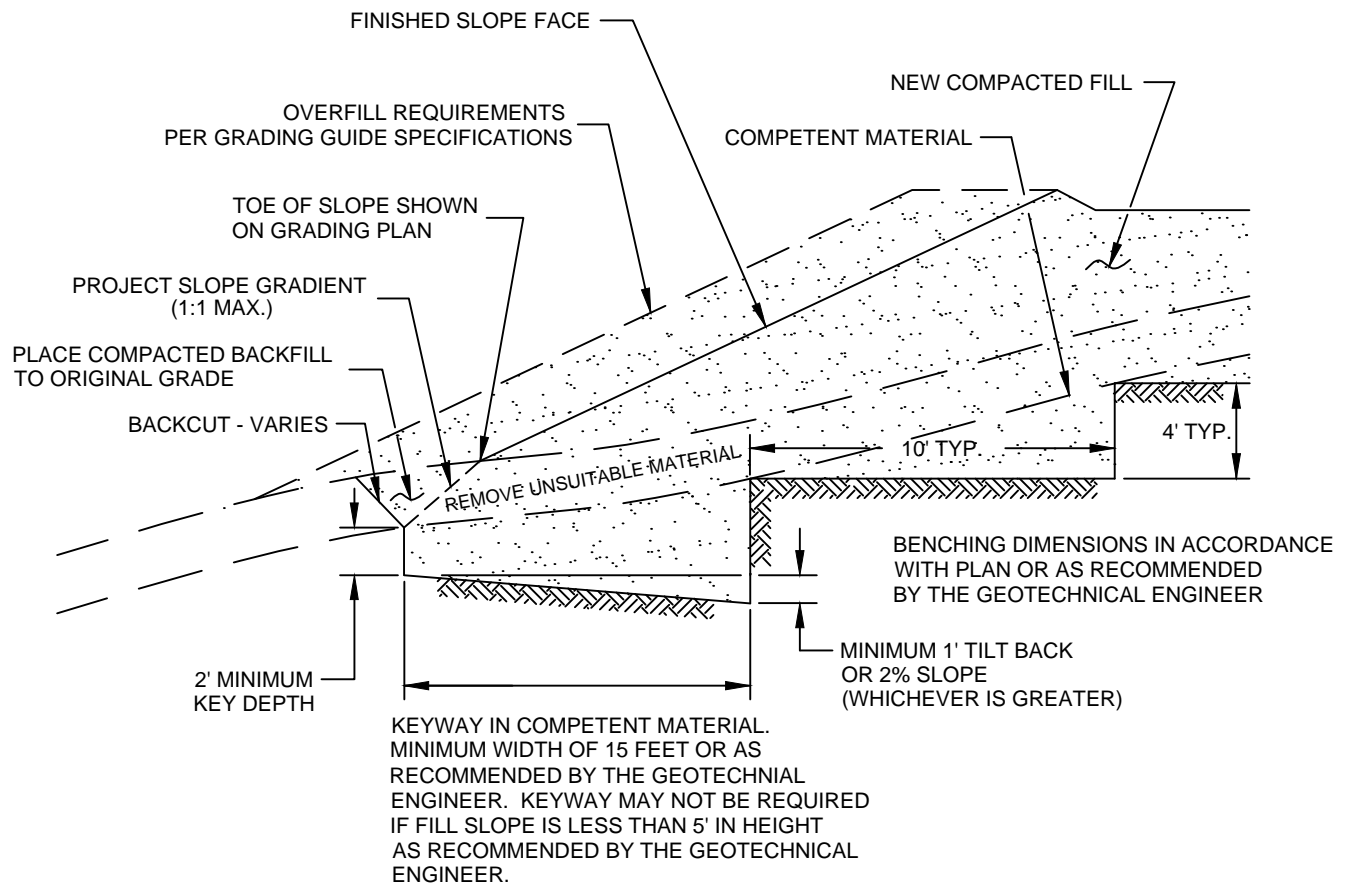


PIPE MATERIAL
ADS (CORRUGATED POLETHYLENE)
TRANSITE UNDERDRAIN
PVC OR ABS: SDR 35
SDR 21

DEPTH OF FILL OVER SUBDRAIN
8
20
35
100

**SCHEMATIC ONLY  
NOT TO SCALE**

CANYON SUBDRAIN DETAIL	
GRADING GUIDE SPECIFICATIONS	
NOT TO SCALE	
DRAWN: JAS CHKD: GKM	
PLATE D-3	
 <b>SOUTHERN CALIFORNIA GEOTECHNICAL</b>	



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

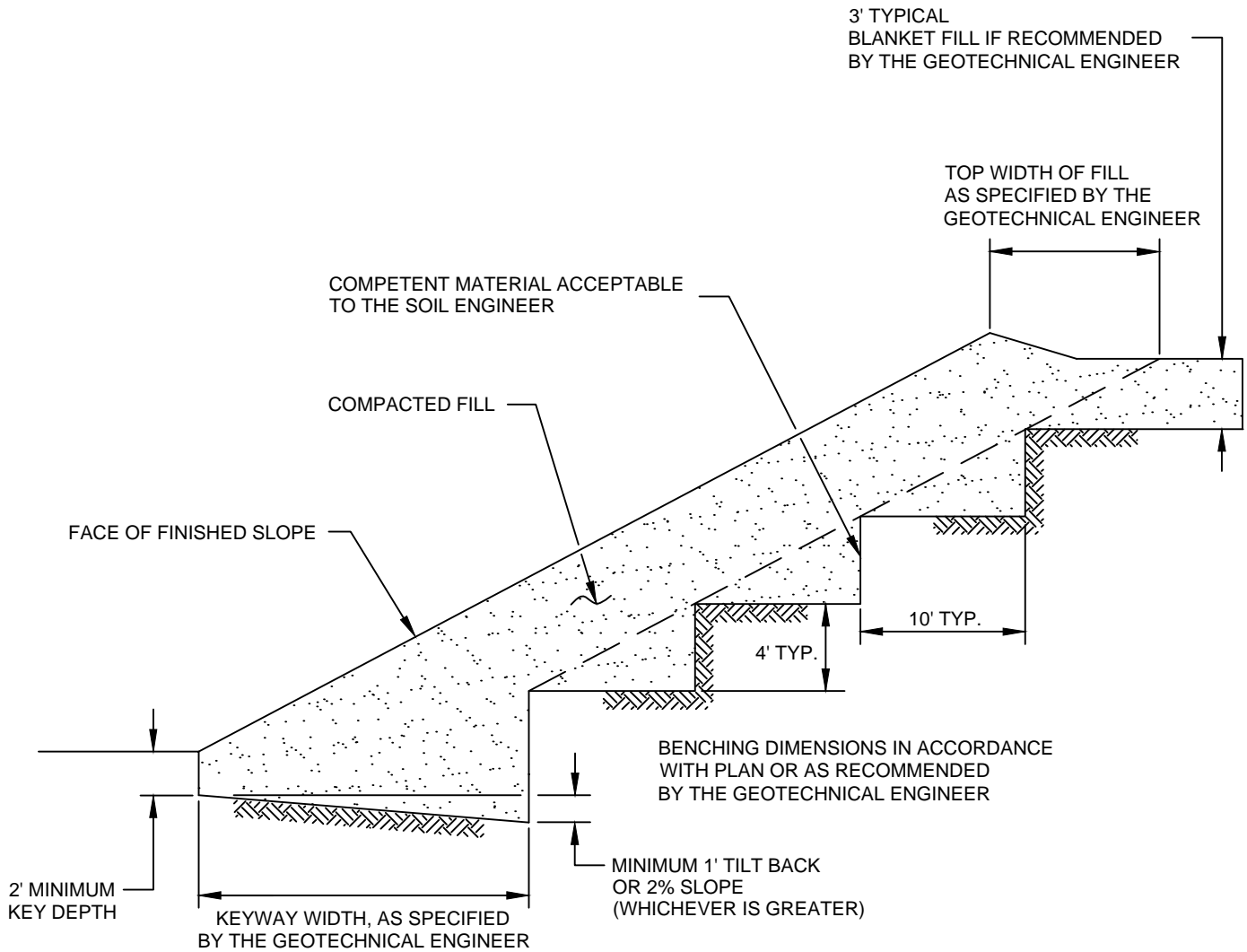
NOT TO SCALE


DRAWN: JAS  
CHKD: GKM

PLATE D-4

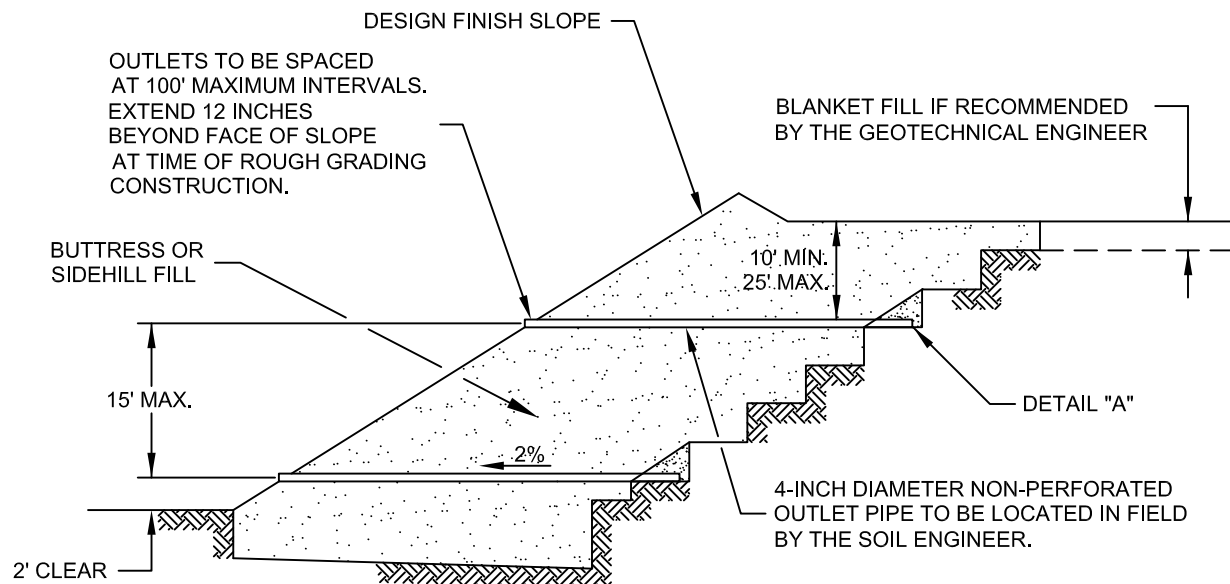


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STABILIZATION FILL DETAIL	
GRADING GUIDE SPECIFICATIONS	
NOT TO SCALE	 <b>SOUTHERN CALIFORNIA GEOTECHNICAL</b>
DRAWN: JAS CHKD: GKM	
PLATE D-5	





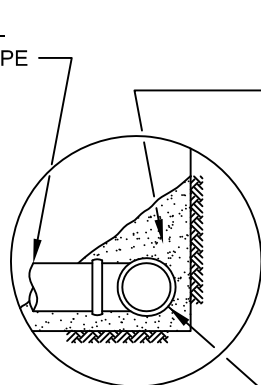
"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO EMA STD. PLAN 323)

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



DETAIL "A"

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.

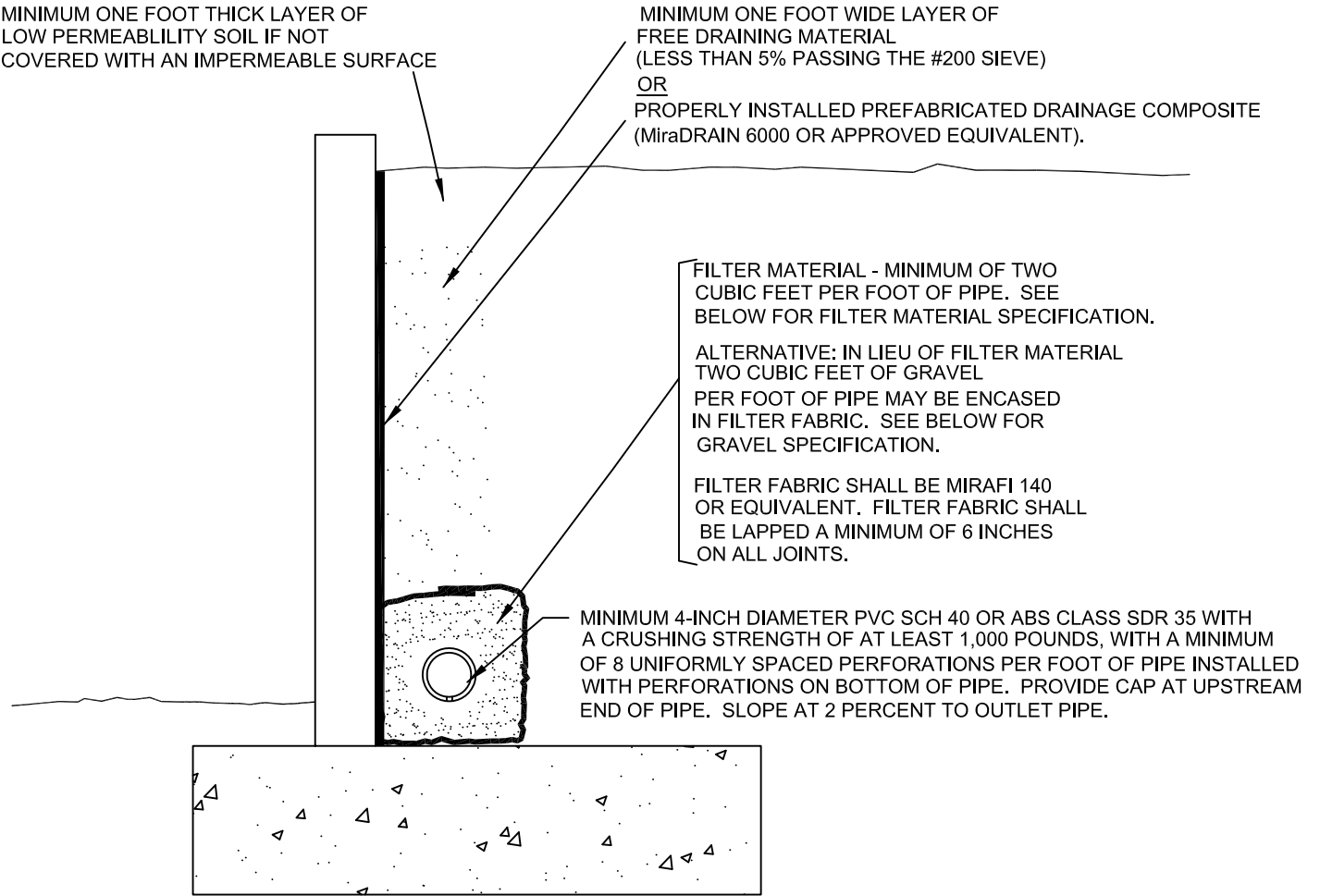
FILTER FABRIC SHALL BE MIRAFI 140 OR EQUIVALENT. FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 12 INCHES ON ALL JOINTS.

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.

NOTES:

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

SLOPE FILL SUBDRAINS	
GRADING GUIDE SPECIFICATIONS	
NOT TO SCALE	 <p>SOUTHERN CALIFORNIA GEOTECHNICAL</p>
DRAWN: JAS CHKD: GKM	
PLATE D-6	




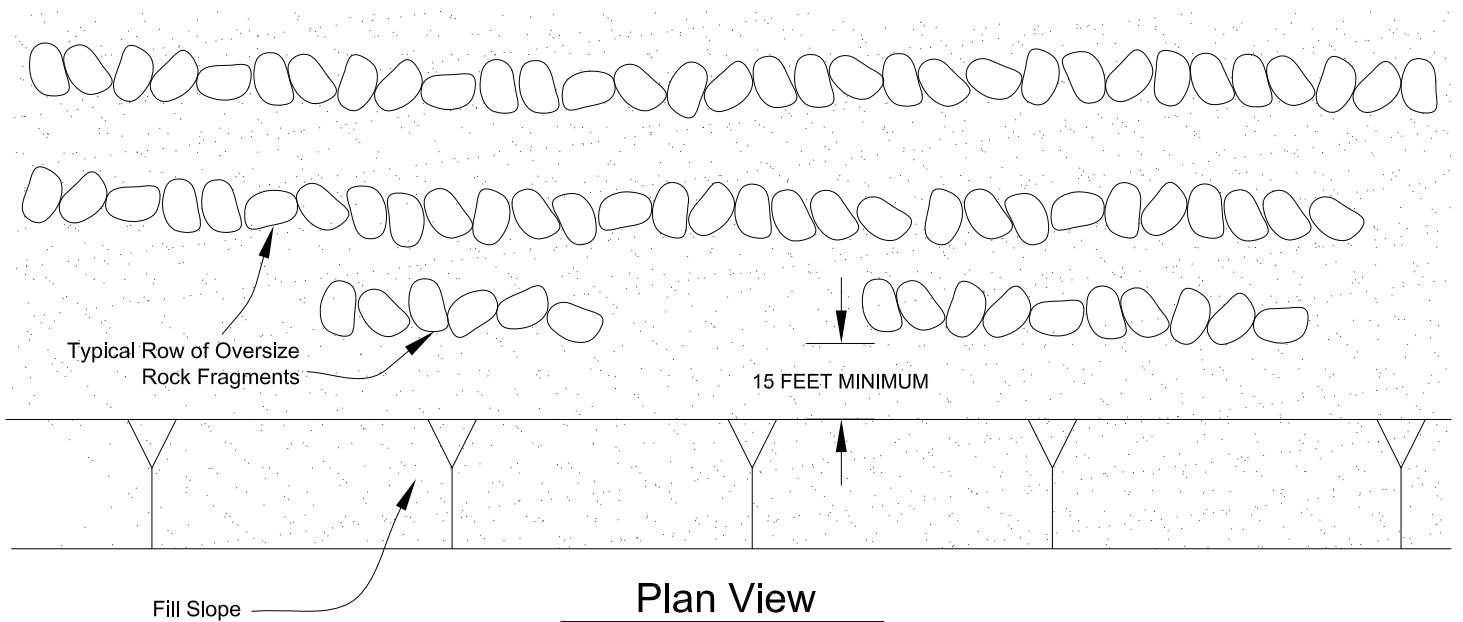
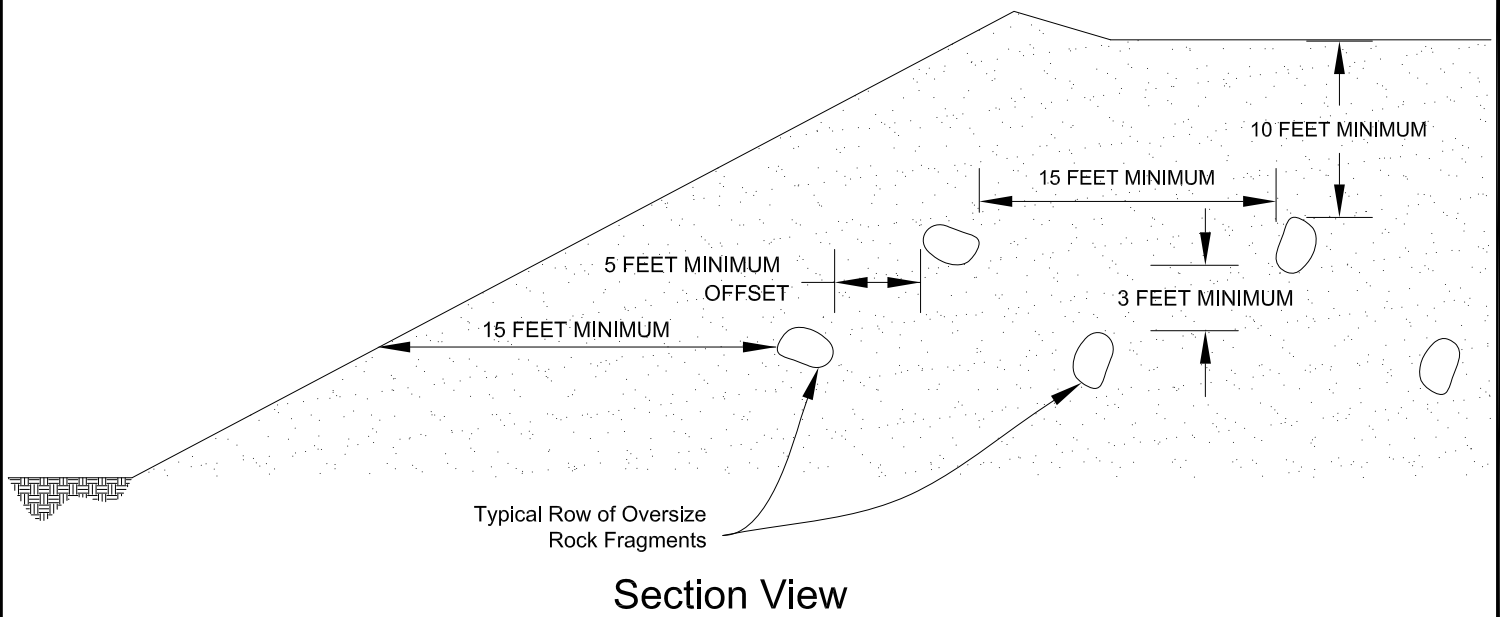
"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO EMA STD. PLAN 323)

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	
SOUTHERN CALIFORNIA GEOTECHNICAL	



**PLACEMENT OF OVERSIZED MATERIAL**  
**GRADING GUIDE SPECIFICATIONS**

NOT TO SCALE

DRAWN: PM  
 CHKD: GKM

PLATE D-8



**SOUTHERN  
 CALIFORNIA  
 GEOTECHNICAL**

# APPENDIX

# USGS Design Maps Summary Report

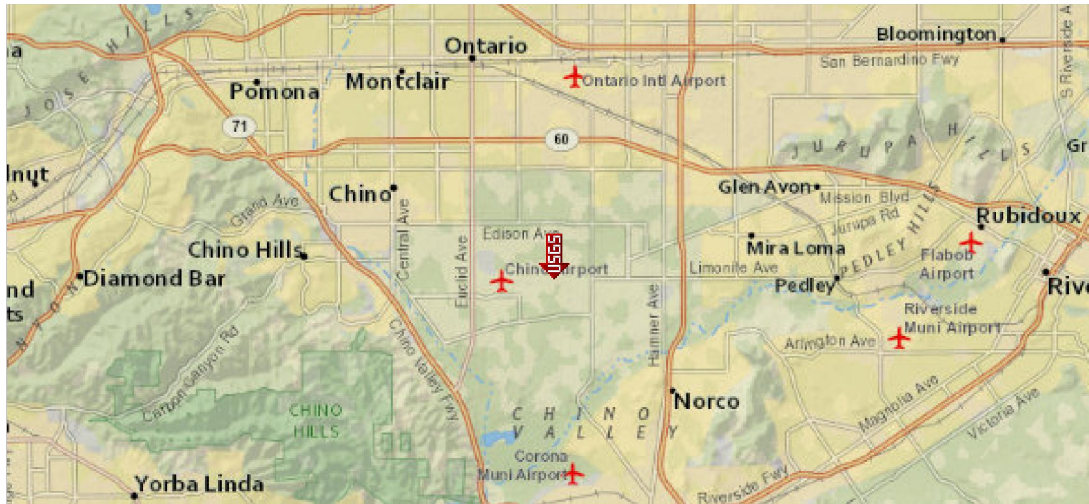
## User-Specified Input

**Building Code Reference Document** ASCE 7-10 Standard  
(which utilizes USGS hazard data available in 2008)

**Site Coordinates** 33.98492°N, 117.61167°W

**Site Soil Classification** Site Class D – “Stiff Soil”

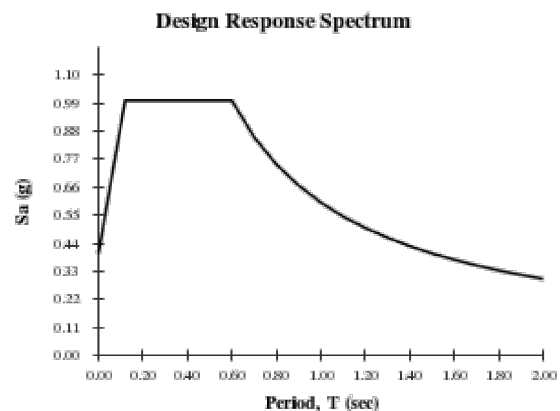
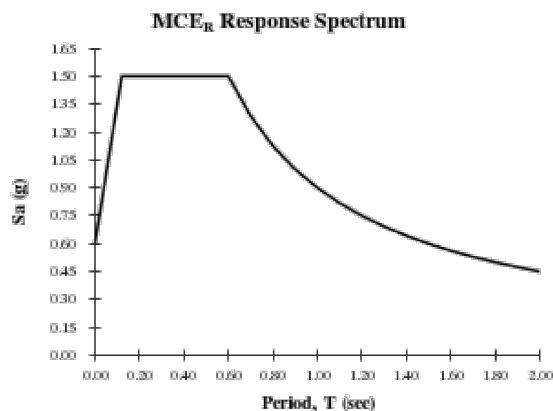
**Risk Category** I/II/III



## USGS-Provided Output

$S_s = 1.500 \text{ g}$        $S_{MS} = 1.500 \text{ g}$        $S_{DS} = 1.000 \text{ g}$   
 $S_1 = 0.600 \text{ g}$        $S_{M1} = 0.900 \text{ g}$        $S_{D1} = 0.600 \text{ g}$

For information on how the  $S_s$  and  $S_1$  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: CT	 <b>SOUTHERN CALIFORNIA GEOTECHNICAL</b>
CHKD: RGT	
SCG PROJECT 18G174-1	
PLATE E-1	