Terracon GeoReport

Geotechnical Investigation and Geologic Evaluation Report

Tentative Tract No. 37305
Lake Elsinore, California

February 2, 2018
Terracon Project No. CB175281

Prepared for:
Nichols Road Partners

Prepared by:
Terracon Consultants, Inc.
Colton, California

February 2, 2018

Nichols Road Partners
25555 Maitri Road
Corona, California 92877

Attn: Mr. Todd Pendergrass
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Re: Geotechnical Investigation and Geologic Evaluation Report
Tentative Tract No. 37305
Nichols Road and Interstate 15
Lake Elsinore, California
Terracon Project No. CB175281

Dear Mr. Pendergrass:

We have completed the Geotechnical Investigation and Geologic Evaluation services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PCB175281 dated December 22, 2017, and other written and verbal communications. As noted in our proposal, this report includes the previous geotechnical investigation prepared by this firm and adds the CEQA items. We expect your consultant will use the findings and recommendations from our Geotechnical/Geologic Evaluation report to prepare a CEQA document.

Our report includes data from the U.S. Department of Agriculture for the soils found on site, as well as a discussion of the mineral resource potential for the area of your project. Although the site is not within a state- or county-designated earthquake fault zone, nonetheless the site is within a seismically active region. The report therefore summarizes important faults in the area of your project and discusses potential geotechnical/geologic concerns, such as fault rupture, liquefaction and erosion.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Fred Yi, Ph.D., G.E. 2967
Senior Associate

REGISTERED PROFESSIONAL ENGINEER
FENG YI
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GEOTECHNICAL
STATE OF CALIFORNIA

Jay J. Martin, Principal for
Patrick Dell, G.E.
Authorized Project Reviewer

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon GeoReport logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

REPORT SUMMARY

Topic [1]	Overview Statement [2]
Project Description	The project consists of approximately 71 acres that includes the Nichols Road grading project previously investigated by CHJ Consultants. Grading observation and compaction test of the Nichols Road grading project is in progress by CHJ Consultants, a Terracon Company. TTM 37305 generally includes the Nichols Road grading project and some additional acreage located to the south. The project consists of approximately 9 acres of commercial property, including a hotel, single-family residential lots, a recreational area, three Water Quality Management Plan (WQMP) basins, and an open space (recreation) area. Temescal Canyon High School is located southeast and southwest of the site.
Geotechnical Characterization	The north portion of the subject site has been graded. The geotechnical characterization of the south portion (ungraded) of the subject site is as followings. ■ No undocumented fill encountered ■ Loose sandy soils to 5 feet deep locally ■ Medium dense to very dense silty sand and sandy silt encountered up to 10 to 51.5 feet ■ Bedrock encountered at depths between approximately 20 and 51.5 feet ■ Groundwater not encountered
Earthwork	■ Mandatorily remove 12 inches existing soils in all areas to be graded ■ Remove all existing fill where encountered. ■ Remove all loose native soils with relative compaction less than 85%
Shallow Foundations	Shallow foundations will be sufficient ■ Allowable bearing pressure = 2,500 lbs/sq ft ■ Minimum footing size = 18"×18" ■ Minimum footing depth = 12" Expected settlements: < 1 inch total, < ½ inch differential Detect and remove zones of fill and loose soils as noted in **Earthwork**
Deep Foundations	Deep foundations are not necessary for this site
Free-Standing Retaining Walls	Retaining walls up to approximately 25 feet high may be utilized
Pavements	With subgrade prepared as noted in **Earthwork** Asphalt for graded area: ■ Auto Parking Areas: 0.25' HMA[3]/0.35' Class 2 AB[4] ■ Auto Roads: 0.25' HMA/0.50' Class 2 AB ■ Truck Parking Areas: 0.30' HMA/0.50' Class 2 AB ■ Truck Ramps and Roads: 0.40' HMA/0.75' Class 2 AB Asphalt for non-graded area: ■ Auto Parking Areas: 0.25' HMA[3]/0.45' Class 2 AB[4] ■ Auto Roads: 0.25' HMA/0.55' Class 2 AB ■ Truck Parking Areas: 0.30' HMA/0.60' Class 2 AB ■ Truck Ramps and Roads: 0.40' HMA/0.90' Class 2 AB Concrete for all areas:

	■ Light Duty: 4.5" PCC/Compacted Fill ■ Medium Duty: 5.5" PCC/Compacted Fill ■ Dumpster Pad: 7.0" PCC/Compacted Fill
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.
3. HMA = hot mix asphalt
4. AB = aggregate base

Geotechnical Investigation and Geologic Evaluation Report

Tentative Tract No. 37305
Nichols Road and Interstate 15
Lake Elsinore, California

Terracon Project No. CB175281

February 2, 2018

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed Tentative Tract No. 37305 to be located at Nichols Road and Interstate 15 in Lake Elsinore, California. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions and historical high groundwater
- 2016 California Building Code (CBC) seismic design parameters
- Items required by the California Environmental Quality Act (CEQA) for Geology and Soils and Mineral Resources
- Liquefaction potential
- Seismic settlement
- Recommendations for foundation design and concrete slab-on-grade
- Lateral earth pressures
- Subgrade preparation/earthwork recommendations
- Recommendations to mitigate unusual soil conditions encountered
- Recommendations for preliminary pavement section design
- Recommendation for on-site infiltration rate

The geotechnical engineering scope of services for this project included the advancement of 12 additional test borings to depths ranging from approximately 5.0 to 51.5 feet below existing site grades in the south portion of the site. Eight test borings were drilled to depths ranging from approximately 25.5 to 51.5 feet below existing site grades in the north portion of the site during 2016 investigation.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section of this report.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed in the project planning stage. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	Preliminary Lotting Study received on December 15, 2017 prepared by K & A Engineering, supplemented with requested test locations (subsequently revised by email on December 21), and conversations with representatives of K & A and Nichols Road Partners We have not identified some of the parameters listed as assumed or unknown in our proposal. Those remain highlighted in this table.
Project Description	The project consists of approximately 71 acres that includes the Nichols Road grading project previously investigated by CHJ Consultants. Grading observation and compaction test of the Nichols Road grading project is in progress by CHJ Consultants, a Terracon Company. TTM 37305 generally includes the Nichols Road grading project and some additional acreage located to the south. The project consists of approximately 9 acres of commercial property, including a hotel, single-family residential lots, a recreational area, three Water Quality Management Plan (WQMP) basins, and an open space (recreation) area. Temescal Canyon High School is located southeast and southwest of the site.
Proposed Structures	The hotel will be four stories; one and/or two-story commercial structures are also expected. Most of the site will be developed with wood-frame single-family residential structures of one- or two-story construction with slabs on grade
Building Construction	Wood-frame with slab-on--grade
Finished Floor Elevation	Variable, unknown
Maximum Loads	■ Columns: 30 to 100 kips ■ Walls: 1 kips per linear foot (klf) ■ Slabs: 150 pounds per square foot (psf)
Grading/Slopes	Up to 25 feet of cut and 25 feet of fill will be required to develop final grade. Final slope angles of as steep as 2H:1V (Horizontal: Vertical) are expected.
WQMP Basins	Three storm water infiltration basins are anticipated. Depths shown require testing at depths of 7-14 feet below existing grade, depending on the basin finished grade
Free-Standing Retaining Walls	Retaining walls up to approximately 25 feet high may be utilized

Item	Description
Pavements	Paved driveway and parking will be constructed on site. We assume both rigid (concrete) and flexible (asphalt) pavement sections should be considered. Please confirm this assumption. Anticipated traffic indices (TIs) are as follows: ■ Auto Parking Areas: TI=5.0 ■ Auto Roads: TI=5.5 ■ Truck Parking Areas: TI=6.0 ■ Truck Ramps and Roads: TI=8.0 ■ The pavement design period is 20 years. Anticipated average daily truck traffic (ADTT) is as follows for concrete pavement: ■ Light Duty: ADTT=1 (Category A) ■ Medium Duty: ADTT=25 (Category B) ■ Dumpster Pad: ADTT=700 (Category C)
Estimated Start of Construction	Unknown

Previous Investigations

A Preliminary Geotechnical Investigation was performed on a larger parcel that includes the entire site by Geotechnics, Incorporated in 2005. That report addressed geologic hazards including faulting, surface rupture, liquefaction and landslides. That report was utilized where possible during our investigation. Geotechnics, Inc. concluded that the potential for surface rupture, landsliding, liquefaction, flooding or other geologic hazards is low. We are in general agreement with the assessment of geologic hazards presented in their report.

In May 2016, CHJ Consultants, A Terracon Company (currently Colton office of Terracon Consultants Inc.) performed a geotechnical investigation (CHJ Jon No. 16164-3) on approximately 46 acres generally located in the northerly portion of the tract, known as the Nichols Road Grading Project (See **Exploration Plan**). The 2016 report was updated to include CEQA study in May 2017 by Terracon (Terracon Job No. CB175164). The results and recommendations of that report are utilized in this report as needed.

In April 2017 grading of the western portion of the 46 acres (See **Exploration Plan**) began on the site and was in progress during preparation of this report. CHJ Consultants, A Terracon Company, provided observation and compaction testing services during grading.

GEOTECHNICAL OVERVIEW

The CEQA study is summarized in **CEQA Study Conclusions**. Measures mitigating potential hazards are discussed in **Mitigation Measures for Potential Geotechnical Hazards**.

The subsurface soils of the site are described in the **Geotechnical Characterization** section. Based upon our field investigation and test data, it is our opinion that the upper existing soils will not, in their present condition, provide uniform or adequate support for the proposed structure. Based on review of our exploratory boring logs, variable in situ conditions may be present. These conditions may cause unacceptable differential and/or overall settlement upon application of the anticipated foundation loads.

Because of site conditions, it will be necessary to remove the upper 12 inches of soils in all areas to be graded. All existing undocumented fill if encountered should then be completely removed. Additional site preparation recommendations including subgrade improvement and fill placement are provided in the **Earthwork** section.

The **Shallow Foundations** section addresses support of the building structures bearing on engineered fill or competent native soils. The **Slabs-On-Grade** section addresses slab-on-grade support of the buildings. Recommendations for preliminary pavement designs including asphalt concrete pavement and Portland cement concrete pavement are provided in the **Pavements** section.

The **General Comments** section provides an understanding of the report limitations.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located southeast of Nichols Road and Interstate 15, in Lake Elsinore, California. Approximately 71 Acres See **Site Location**

Item	Description
Existing Improvements	The northern portion of the site was graded and fill had been placed prior to this investigation. The fill was observed during placement and has been tested by this firm (CHJ Consultants, a Terracon Company, Project No, CB171111, testing ongoing). Excavation of bedrock hills in the northern portion of the site was ongoing during this investigation. The approximate limits of the existing fill are marked on our **Exploration Plan**. The southern portion of the site had no other existing improvements.
Current Ground Cover	The southern portion of the site is lightly- moderately vegetated with low-lying shrubs and grass; the graded area in the northern portion of the site is devoid of vegetation
Existing Topography	The site generally slopes toward Stovepipe Wash

Historic Aerial Photo Examination

Aerial imagery dated from 1938 to 2017 were examined for indications of past site usage and potential geologic hazards as part of this investigation. The images examined between 1938 and 2005 show the site undeveloped except for dirt roads, which crossed the site. Stockpiles in the northern portion of the site that were present during our previous investigation were first observed in the 2009 aerial image. These stockpiles primarily consisted of revegetation plots prepared for the Chandler Aggregates Nichols Road mine located north of the site. No other pertinent features were observed on the aerial images examined. Indications of geologic hazards such as faulting or landslides were not observed in the aerial imagery examined.

GEOTECHNICAL CHARACTERIZATION

Regional Site Geology

The site is situated in an uplifted and dissected bedrock terrain in the Peninsular Ranges geomorphic province. The Peninsular Ranges include plutonic and metamorphic crystalline rocks of Cretaceous and older age. The crystalline basement rocks are locally mantled by colluvial soils and older sediments. Geologic units in the site area include Mesozoic age metasedimentary and metavolcanic rocks coeval with the plutonic rocks of the Peninsular Ranges batholith and younger alluvial fan sediments of Holocene and late-Pleistocene age.

As mapped by Morton and Weber (2003) and Morton and Miller (2006), the surficial soils of the site are younger alluvial deposits that are underlain by crystalline bedrock units including Mesozoic-age metavolcanics. The **Geologic Index Map** depicts the geologic units in the site region.

Subsurface Profile

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting and planned construction. The north portion of the subject site has been graded in accordance with our recommendations provide in previous report (CHJ Job No. 16164-3 and Terracon Job No. CB175164). The following table provides our geotechnical characterization on the south portion (ungraded) of the subject site.

The geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation, foundation options and pavement options. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/Density
Surface		No top soil was encountered	N/A
1	5 (locally)	Silty sand	Loose
2	10 to 51.5	Silty sand, sand, and sandy silt	Medium dense to very dense
3	20 to 51.5	Bedrock recovered as sandy gravel	Very dense
4	Undetermined: Borings terminated within this stratum at depths of approximately 20.2 to 51.5 feet	Bedrock	--

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was not encountered within the maximum 51-1/2-foot depth reached in the borings.

Historic Groundwater Conditions

The site is located in Section 25 of Township 5 South, Range 5 West, northeast of the Elsinore Groundwater Basin (DWR, 2017). The nearest known well is greater than 1.5 miles south of the

site and is situated in valley sediments. The site is underlain at relatively shallow depth by crystalline bedrock. We observed no seepage, springs or other evidence for a groundwater table within the site boundary during geologic mapping. Groundwater was not encountered within the 51-1/2-foot depth of the current borings. Previous investigations by Geotechnics, Incorporated (2005) reported groundwater as seepage in bedrock or perched on clay layers at depths ranging from 18 to 35 feet bgs. The depth to groundwater on the site is likely to vary seasonally, and perched groundwater may occur at the soil-bedrock contact. For this investigation we have estimated the historic high groundwater level to be 40 feet bgs. The 40-foot historic high is consistent with the depth to groundwater of approximately 40 feet (1915 contours) depicted by Waring (1919).

Hydroconsolidation

The previous investigation performed by Geotechnics, Incorporated indicates some potential for hydroconsolidation of the on-site soils. Hydroconsolidation tests performed by CHJ Consultants in 2016 for samples obtained in north portion of the site indicate a hydroconsolidation strain of 6.5 percent (Enclosures "C-3" through "C-6" in **Previous Exploration Results** section). The hydrocollapsible soils have been removed and recompacted during grading performed in 2017.

On the south portion of the site, the soils encountered are generally granular and in a dense state. Hydroconsolidation potential is considered low.

CEQA STUDY CONCLUSIONS

Subsidence

Portions of the site are located in areas identified as potentially susceptible to subsidence associated with groundwater or petroleum fluid withdrawal, peat oxidation or hydroconsolidation according to the County of Riverside (2017).

Due to the lack of peat or petroleum-associated deposits, petroleum withdrawal and peat oxidation do not appear to be hazards. Based on observations made during grading, the alluvial materials on the site are classified as late Pleistocene in age; therefore, the hazard of subsidence due to groundwater withdrawal appears to be minimal. It is our understanding that the County subsidence zone in this area refers to hydrocollapse potential, which is low in the site's post-grading condition.

Mineral Resources

The aggregate resource potential for the area of the site is addressed in a report titled, "Update of Mineral Land Classification for Portland Cement Concrete-Grade Aggregate in the Temescal

Valley Production Area, Riverside County, California" (CDMG/CGS, 2014). This report addresses the sand and gravel resource potential according to the presence or absence of significant sand and gravel deposits for use in construction-grade aggregate. The resource quality of surrounding lands was reported according to the following Mineral Resource Zone (MRZ) classification system:

MRZ-1: Areas where available geologic information indicates that little likelihood exists for the presence of significant mineral resources.

MRZ-2: Areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood for their presence exists.

MRZ-3: Areas containing mineral occurrences of undetermined mineral resource significance.

MRZ-4: Areas where available information is inadequate for assignment to any other MRZ.

The site is situated in primarily alluvial and colluvial terrain underlain by crystalline metamorphic bedrock. No economically significant sources of aggregate material were observed within the site. The project site is placed near an MRZ-2 zone. Aggregate mining is currently occurring in bedrock outcrops immediately north of the site. The site was examined by geologists from this firm and the site owner and no commercially viable aggregate resources were observed.

As the project area is not presently used for mineral resource extraction and does not contain identified sources of aggregate materials, the proposed project will not result in the loss of availability of any known mineral resources. Thus, no significant impacts are anticipated.

Erosion

The native soils mantling the site are considered moderately to severely susceptible to erosion, based on data available from the USDA (2017). Surficial erosion can be addressed by site development and inclusion/repair of drainage improvements.

Expansive Soils

Plasticity index values available from the USDA (2017) indicate non-plastic soils. All soils materials encountered during this investigation were sufficiently granular to be non-critically expansive; the need for specialized construction procedures to specifically resist expansive soil forces is not anticipated at this time. Requirements for reinforcing steel to satisfy structural criteria are not affected by this recommendation. Additional evaluation of soils for expansion potential should be conducted by the soils engineer during the grading operation.

Volcanic Hazards

The nearest volcanic center to the site is the Lavic Lake Field, which includes Pisgah Crater, located approximately 88 miles to the northeast. The estimated age of last activity within the Lavic Field is 10,000 years before present. The threat potential as listed by USGS (2015) is "low to very low". Volcanic hazards are not expected to affect the site.

Wastewater

The use of septic tanks or other wastewater disposal systems may not be feasible to service the subject project. It is anticipated that the site will be serviced using a sewer system.

Off-Site Impacts

Potential geotechnical impacts to off-site areas are not anticipated due to requirements regarding grading permitting, erosion control and avoidance of non-permitted disturbance to off-site areas required by local regulations. The flat-lying character of site and adjacent topography precludes slope effects to off-site or adjacent properties.

MITIGATION MEASURES FOR POTENTIAL GEOTECHNICAL HAZARDS

General

As a part of mitigation for the project on a general basis, existing and proposed structures and site infrastructure and improvements will be designed and constructed in compliance with applicable building codes. The County of Riverside will require that local building code requirements and project considerations be met prior to issuing a building permit. Proper design and construction in conformance with the recommendations of project geotechnical reports, and compliance with applicable building codes, will reduce the potential adverse impacts of identified geotechnical hazards.

Seismicity and Ground Shaking

The potential for strong ground shaking at the site during the design life of the proposed project is moderate to high. The proposed improvements and structures will be designed according to seismic design parameters and procedures presented in the applicable building code for earthquake ground motions that are expected to occur in the site region. While potential impacts of ground shaking that could affect the proposed development will be reduced with proper design and construction, adverse effects due to ground shaking can occur.

Surface Fault Rupture Potential

For planning purposes, faults in California are generally classified as active, potentially active or inactive. Active faults are those that exhibit surface displacement within Holocene time (about the last 11,000 years). Potentially active faults are those that exhibit evidence of surface displacement during Quaternary time (last 1.6 million years) but not Holocene displacement. Inactive faults have not shown evidence of movement in the last 1.6 million years.

The site does not lie within or immediately adjacent to an Alquist Priolo Earthquake Fault Zone designated by the State of California to include traces of suspected active faulting. The closest APZs are designated for the Elsinore fault zone, located approximately 1.5 miles southwest of the site. According to the County of Riverside (2017), the site is not located in a County-designated Earthquake Fault Zone.

Slope Stability

The relatively flat-lying topography of the site and surrounding area precludes the potential for instability of natural slopes. Site development will include geotechnical evaluation of existing fill slopes and, if required, engineered grading or foundation designs that reduce the potential for slope instability of fill slopes. The potential for landslide or slope instability is considered low.

Erosion

The native soils mantling the site are considered moderately to severely susceptible to erosion, based on data available from the USDA (2017). Positive drainage should be provided, and water should not be allowed to pond anywhere on the site. Water should not be allowed to flow over any graded or natural areas in such a way as to cause erosion. Finish graded areas should be protected from the effects of runoff so as to reduce the potential impact from erosion to a less than significant level.

Expansive or Corrosive Soils

The on-site soils are granular and are not considered critically expansive. Soils utilized beneath structures should consist of granular, non-clay-bearing soils.

Chemical tests performed for the prior site investigation indicates that the soil tested are considered potentially "mildly" corrosive to ferrous metals at as-received condition and "moderately" corrosive at saturated condition. Ammonium and nitrate levels did not indicate a concern as to corrosion of buried copper. Results of the soluble sulfate testing indicate a "not applicable" (Class S0) anticipated exposure to sulfate attack.

Subsidence

Portions of the site are located in areas identified as susceptible to subsidence according to the County of Riverside (2017). Due to the lack of associated deposits, petroleum withdrawal and peat oxidation do not appear to be hazards. Based on observations made during grading, the alluvial materials on the site are classified as late Pleistocene in age; therefore, the hazard of subsidence due to groundwater withdrawal appears to be minimal. It is our understanding that the County subsidence zone in this area refers to hydrocollapse potential, which is low in the site's post-grading condition.

Mineral Resources

The project area is not presently used for mineral extraction, and as no documented mineral resources have been identified on or adjacent to the project area, the proposed project will not result in the loss of availability of any known mineral resources. Thus, no significant impacts are anticipated.

SITE GEOLOGY

Fault Rupture Potential

The site is not located within an Alquist-Priolo Earthquake Fault Zone (APZ) designated by the State of California for active faults. The closest APZ boundary, designated for the Elsinore fault zone, is located approximately 1.5 miles southwest of the site. According to the County of Riverside (2017), the site is not located in a County-designated Earthquake Fault Zone. Known faults or fault-related features are not located within the site; therefore, the potential for fault rupture within the site is considered low.

Regional Faults

Elsinore Fault Zone

The Glen Ivy North segment of the Elsinore fault zone is the nearest major active fault, about 1.6 miles southwest of the site. The Elsinore fault zone is typified by multiple en echelon and diverging faults. To the north, it splays into the Whittier and Chino faults. The Elsinore is primarily a strike-slip fault zone; however, transtentional features such as the graben of the Elsinore and Temecula Valleys also occur. Most Elsinore fault traces are demonstrably active (Holocene) as documented by Saul (1978), Rockwell and others (1986) and Wills (1988).

The southern segment of the northwest-trending Chino-Central Avenue fault, a northern splay of the Elsinore fault zone, is approximately 22 miles northwest of the site and is assigned a 6.8 magnitude by Petersen and others (2008).

The west- to northwest-trending Whittier fault is approximately 23 miles northwest of the site. The Whittier fault exhibits almost pure right-lateral strike slip (Rockwell and others, 1986). Evidence for activity includes offset of Holocene sediments (Hannan and Lung, 1979) and historic microseismicity (Yerkes, 1985). The Working Group on California Earthquake Probabilities (1995) tentatively assigned a 5 percent probability of a major earthquake on the Whittier fault for the 30-year interval from 1994 to 2024.

San Jacinto Fault Zone

The San Jacinto fault zone is a system of northwest-trending, right-lateral, strike-slip faults. The San Jacinto Valley segment is approximately 18.5 miles northeast of the site. More large historic earthquakes have occurred on the San Jacinto fault than any other fault in Southern California (Working Group on California Earthquake Probabilities, 1988).

Based on the data of Matti and others (1992), a portion of the San Jacinto fault may accommodate most of the slip between the Pacific and the North American plates. Matti and others (1992) suggest this motion is transferred to the San Andreas fault in the Cajon Pass region by "stepping over" to parallel fault strands that include the Glen Helen fault.

San Andreas Fault Zone

The San Andreas fault zone is located along the southwest margin of the San Bernardino Mountains, approximately 30 miles north-northeast of the site. The mountain front in the San Bernardino area approximately marks the active trace of the San Andreas fault, here characterized by youthful fault scarps, vegetation lineaments, springs and offset drainages. Field and others (2008) assigned a 53 percent probability to a magnitude 6.7 or greater earthquake occurring on the southern segment of the San Andreas fault between 2014 and 2044.

Blind Thrust Faults

The San Joaquin Hills Thrust (SJHT) fault is an inferred blind thrust beneath the San Joaquin Hills in coastal Orange County, southern California. The vertical surface projection of the San Joaquin Hills blind thrust is approximately 20 miles west-southwest of the site. The SJHT is southwest dipping and presumably gave rise to uplift of the San Joaquin Hills. Measurement of uplifted back-bay shorelines and fossil dating suggests an uplift rate of 0.24 meter per 1,000 years and an average earthquake recurrence of 2,500 years on the SJHT (Grant and others, 1999). The SJHT has a postulated potential to produce earthquakes with magnitudes up to Mw 7.3. A latest large event may have occurred in 1769 A.D. based on radiocarbon dating of uplifted marsh sediments (Grant and others, 1999).

The Puente Hills Blind-Thrust (PHBT), located approximately 32 miles to the west-southwest, is a system of buried thrust fault ramps that extend from beneath Los Angeles to the Puente Hills of eastern Los Angeles County and Orange County. The PHBT is identified in the subsurface by

seismic reflection profiles, petroleum well data and precisely located seismicity and at the surface by a series of contractional folds. Fault segments of the PHBT are the Los Angeles, Santa Fe Springs and Coyote Hills (Shaw and Shearer, 1999). This buried fault system is capable of producing estimated earthquakes of Mw 6.5 to 6.6 on individual segments or an Mw 7.1 earthquake as a group (Shaw and others, 2002). A study utilizing borehole data collected from sediments overlying the central segment of the PHBT indicates that subtle folding locally extends to the near surface and that four fault slip events occurred in the past 11,000 years (Dolan and others, 2003).

Local Faults

No active faults were identified within the site area during our review of published and unpublished literature and maps, stereoscopic aerial photographs or field mapping. Accordingly, ground fault rupture is not anticipated.

Weber (1977) mapped a postulated north-west trending fault at the contact between bedrock and alluvium along the base of site slopes. Examination of exposures along this trend did not indicate a fault at the mapped location. The occurrence of the Mzu unit north and south of Nichols Road suggests continuity (unfaulted) bedrock.

Historical Earthquakes

A map of recorded earthquake epicenters is included as the **Earthquake Epicenter Map**. The epicenters and magnitudes are based on data from a USGS earthquake catalog. This enclosure presents circles as epicenters of earthquakes with magnitude equal to or greater than magnitude 4.5 recorded from 1918 through 2017. From a ground-shaking standpoint the most significant fault for the site is the Elsinore fault, about 1.6 miles to the southwest.

The site is located within the seismically-active southern California region. The following table summarizes the historic seismic events in the site region.

Summary of Historic Seismicity				
Event ID	**Date**	**Magnitude**	**Distance from LLU Campus (miles)**	**Direction from Site**
Whittier Narrows	10/1/1987	5.9	47	W
Upland	2/28/1990	5.4	26	NW
Sierra Madre	6/28/1991	5.8	45	NW
Landers	6/28/1992	7.3	48	NE
Big Bear	6/28/1992	6.4	27	NE
Northridge	1/17/1994	6.7	75	NW
Hector Mine	10/16/1999	7.1	69	NE
Yucaipa (14155260 [1])	6/16/2005	4.9	8.7	E
14355252	3/8/2008	3.9	13	NW
Chino Hills	7/29/2008	5.4	29	SW
11006189 [1]	9/14/2011	4.2	13	SE
15141521 [1]	4/28/2012	3.8	16	NW

1. SCSN earthquake catalog

Any of the active faults of the Inland Empire area are capable of producing strong ground shaking during earthquakes. Construction of site improvements according to applicable building codes can mitigate the potential for damage to site facilities.

Tsunamis, Inundation, Seiche, and Flooding Potential

The site is not located in a coastal area; therefore, tsunamis are not considered a hazard at the site.

According to the County of Riverside (2017), the site is not located within a potential inundation area for seismically induced dam/reservoir failure. Open reservoirs are not located up gradient from the site; therefore, inundation or seiches are not considered hazards at the site.

The majority of the site is not located in an area designated by the Federal Emergency Management Agency (2008) as a flood hazard zone. Stovepipe Canyon Creek, which crosses the site, is considered to be in a 100-year flood zone. The County of Riverside (2017) notes the same area as a zone of "flooding sensitivity." A more accurate determination of the flood hazard to the site and the adequacy of existing flood and drainage improvements near the site is not within the scope of this investigation. Based on the anticipated grading planned at the site, flooding is not considered a significant hazard.

SEISMIC CONSIDERATIONS

The tectonics of the Southern California area are dominated by the interaction of the North American and Pacific tectonic plates, which are sliding past each other in transform motion. Although some of the motion may be accommodated by rotation of crustal blocks such as the western Transverse Ranges (Dickinson, 1996), the San Andreas fault zone is thought to represent the major surface expression of the tectonic boundary and to accommodate most of the slip between the Pacific and North American plates. Some of the slip is accommodated by other northwest-trending strike-slip faults that are related to the San Andreas system, such as the San Jacinto and Elsinore faults. Local compressional or extensional strain resulting from the transform motion along this boundary is accommodated by left-lateral, normal and reverse faults such as the Cucamonga fault

Seismic Design Parameters

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The seismic design parameters, according to the 2016 California Building Code (CBC) are provided in the following table.

Description	Value
2016 California Building Code Site Classification (IBC) [1]	D [2]
Site Latitude	33.7055°
Site Longitude	-117.3524°
Mapped Spectral Acceleration Parameters [3]	S_S = 2.25 and S_1 = 0.89
Site Coefficients [3]	F_A = 1.0 and F_V = 1.5
Adjusted Maximum Considered Earthquake Spectral Response Parameters Design Spectral Acceleration Parameters[3]	SM_S = 2.25 and SM_1 = 1.34
Design Spectral Acceleration Parameters[3]	SD_S = 1.50 and SD_1 = 0.89
Peak Ground Acceleration[3]	0.87g
De-aggregated Magnitude	6.77

Description	Value

1. Seismic site classification in general accordance with the *2016 California Building Code*, which refers to ASCE 7-10.
2. The 2016 California Building Code (CBC) uses a site profile extending to a depth of 100 feet for seismic site classification. Borings at this site were extended to a maximum depth of 51.5 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.
3. These values were obtained using online seismic design maps and tools provided by the USGS (http://earthquake.usgs.gov/hazards/designmaps/).

LIQUEFACTION AND SEISMIC SETTLEMENT

Liquefaction Potential

Liquefaction is a process in which strong ground shaking causes saturated soils to lose their strength and behave as a fluid. Ground failure associated with liquefaction can result in severe damage to structures. Soil types susceptible to liquefaction include sand, silty sand, sandy silt, and silt, as well as soils having a plasticity index (PI) less than 7 (Boulanger and Idriss, 2006). Loose soils with a PI less than 12 and moisture content greater than 85 percent of the liquid limit are also susceptible to liquefaction (Bray and Sancio, 2006). For sandy soils, the geologic conditions for increased susceptibility to liquefaction are: 1) shallow groundwater (generally less than 50 feet in depth), 2) the presence of unconsolidated sandy alluvium, typically Holocene in age, and 3) strong ground shaking. All three of these conditions must be present for liquefaction to occur. The site is located within an area identified as having a moderate potential for liquefaction by the City of Lake Elsinore (2011) and the County of Riverside (2017).

Due to the potential for shallow groundwater beneath the site, the liquefaction potential of the site has been evaluated based on the SPT data obtained and using the simplified procedure described by Seed and Idriss (1982), Seed and others (1985), modified in the 1996 National Center for Earthquake Engineering Research (NCEER) and 1998 NCEER/National Science Foundation (NSF) workshops (Youd and Idriss, 2001), and as recently summarized by Idriss and Boulanger (2008). The method of evaluating liquefaction potential consists of comparing the cyclic stress ratio (CSR) developed in the soil by the earthquake motion to cyclic resistance ratio (CRR), which will cause liquefaction of the soil for a given number of cycles. In the simplified procedure, the CSR developed in the soil is calculated from a formula that incorporates ground surface acceleration, total and effective stresses in the soil at different depths (which in turn are related to the location of the groundwater table), non-rigidity of the soil column and a number of simplifying assumptions.

For sandy soils, the CRR that will cause liquefaction is related to the relative density of the soil, expressed in terms of SPT blowcounts $(N_1)_{60}$ (Seed and Idriss, 1982; Seed and others, 1985;

Youd and Idriss, 2001; Idriss and Boulanger, 2008), cone penetration resistance (q_{c1N}) (Robertson and Wride, 1998; Youd and Idriss, 2001; Idriss and Boulanger, 2008) or shear wave velocity (V_{s1}) (Andrus and Stokoe, 2000; Youd and Idriss, 2001; Andrus and others, 2004), all normalized for an effective overburden pressure of 1 ton per square foot and corrected to equivalent clean sand resistance. For clayey soils, the CRR is related to cyclic undrained shear strength ratio, s_u/σ_{vc}' (Idriss and Boulanger, 2008). For this investigation, SPT blowcounts were obtained and utilized in the analysis. The project groundwater depth of 40 feet bgs was utilized to calculate the liquefaction potential in the area. The recommended design PGA of 0.87g and a deaggregated earthquake magnitude (M_w) of 6.77 were utilized as input into the liquefaction analysis program GeoSuite©, version 2.4 (Yi, 2016).

For the subject site, liquefaction potential was evaluated based on the Idriss and Boulanger (2008) method.

Liquefaction potential was evaluated for the soil profiles encountered in Exploratory Boring Nos. 3, 6 and 8. Seismic settlement was estimated for the same soil profiles utilized in the liquefaction analyses. The results of liquefaction potential and seismic settlement evaluations are shown in Enclosures "D-1" through "D-3" (**Previous Exploration Results** section) and Exhibit D-1 for existing site conditions. The liquefaction potential was also evaluated for post-grading conditions. The results are shown in Enclosure "D-4" (**Previous Exploration Results** section) for 2016 Exploratory Boring No. 3.

Our calculations indicate that liquefaction could occur within thin localized layers in Exploratory Boring No. 3 (2016).

Seismic Settlement

Prediction of seismic-induced settlement is also important. Seismic-induced settlement includes settlement that occurs both in dry sands and saturated sands (California Geological Survey, 2008). Severe seismic shaking may cause dry sands to densify, resulting in settlement expressed at the ground surface. Seismic settlement in dry soils generally occurs in loose sands and silty sands, with cohesive and fine-grained soils being less prone to significant settlement. For saturated soils, significant settlement is anticipated if the soils exhibit liquefaction during seismic shaking.

The methods for evaluating seismic settlement in saturated sands can generally be classified into two groups. The method for the first group was developed during the 1970s and 1980s, generally based on the relationship between cyclic stress ratio, $(N_1)_{60}$, and volumetric strain (Silver and Seed, 1971; Lee and Albaisa, 1974; and Tokimatsu and Seed, 1987). The method for the second group was developed in the early 1990s with the paper by Ishihara and Yoshimine (1992) as the first publication in the category, modified and improved by various researchers (Robertson and Wride, 1998; Yoshimine et al., 2006; Idriss and Boulanger, 2008; and Yi, 2010), and is generally

based on the relationship between volumetric strain and the factor of safety for liquefaction. Idriss and Boulanger (2008) modified the methods to incorporate both SPT and CPT data. Yi (2010) modified the methods to incorporate shear wave velocity data.

Research related to the estimation of dry sand settlement during earthquake excitation was initiated in the early 1970s by Silver and Seed (1971), followed by the works of several researchers (Seed and Silver, 1972; Pyke et al., 1975; Tokimatsu and Seed, 1987; and Pradel, 1998). A simplified method of evaluating earthquake-induced settlements in dry, sandy soils based on the Tokimatsu and Seed procedure has been developed by Pradel (1998) and is recommended by Martin and Lew (1999) as one of the standard methods for the estimation of earthquake-induced settlements of dry sands in California. In recent years, research was performed by the University of California, Los Angeles (Duku et al., 2008; Yee et al., 2014; Stewart, 2014), and a new volumetric strain material model (VSMM) was proposed. The new UCLA VSMM was developed based on a series of laboratory test results and is able to consider the effects of overburden pressure, fines contents and degree of saturation. This new model was utilized for hospital projects and approved by OSHPD. All of these methods including the latest UCLA method were incorporated into a liquefaction and seismic settlement program, GeoSuite©, version 2.4 (Yi, 2016).

For the subject site, liquefaction-induced settlement was evaluated based on the Idriss and Boulanger (2008) method, and the seismic settlement of dry sands was evaluated based on UCLA method (Duku et al., 2008; Yee et al., 2014; Stewart, 2014).

Our analysis indicates that seismic settlement (including liquefaction-induced settlement and dry sand settlement) could range from approximately 0.0 to 1.3 inches for existing conditions, and the maximum seismic settlement is anticipated to be 1.6 inches. However, due to the thin liquefiable layer and thick, upper non-liquefiable layer, the potential for surface manifestation after grading is limited. We expect the maximum seismic settlement for post-grading condition of less than 1/2 inch considering the non-uniformity of soil layers of the site. The impact of seismic settlement on the project is considered to be low.

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in **Earthwork**, conventional spread foundations, either individual spread footings and/or continuous wall footings, may be utilized for the proposed building structures. The following design parameters are applicable for shallow foundations.

Design Parameters – Compressive Loads

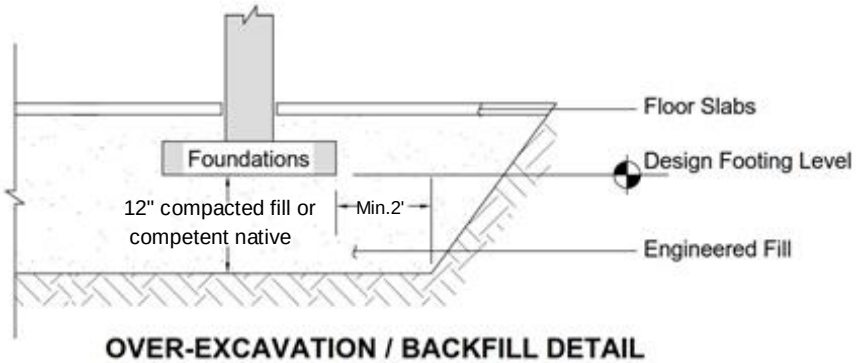
Item	Description
Maximum Net Allowable Bearing Pressure [1, 2]	3,500 psf for isolated footing 1,800 psf for continuous footing
Required Bearing Stratum [3]	12" compacted fill or competent native soil
Minimum Foundation Dimensions	24" for isolated footing 12" for continuous footing
Minimum Footing Depth [4]	12" below finish grade
Ultimate Passive Resistance [5] **(equivalent fluid pressures)**	430 psf/ft
Ultimate Coefficient of Sliding Friction [6]	0.39 (on-site material)
Estimated Total Settlement from Structural Loads [2]	Less than about 1"
Estimated Differential Settlement [2, 8]	About 1/2 of total settlement

1. The net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation and the pressure for the minimum footing size and embedded depth. An appropriate factor of safety has been applied. These bearing pressures can be increased by 1/3 for transient loads unless those loads have been factored to account for transient conditions. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.
2. The maximum net allowable bearing pressure is the pressure for maximum loads noted in **Project Description**.
3. Unsuitable or loose soils should be over-excavated and replaced according to the recommendations presented in the **Earthwork**.
4. Minimum depth below finish grade refers to the lowest adjacent grade within 5 feet of the perimeter of the structure.
5. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted structural fill be placed against the vertical footing face. A factor of safety of 2.0 is recommended.
6. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions. A factor of safety of 1.5 is recommended.
7. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
8. Differential settlements are as measured over a span of 50 feet.

Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the geotechnical engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

Over-excavation for structural fill placement below footings should be conducted as shown below. The over-excavation should be backfilled up to the footing base elevation as recommended in the **Earthwork** section.

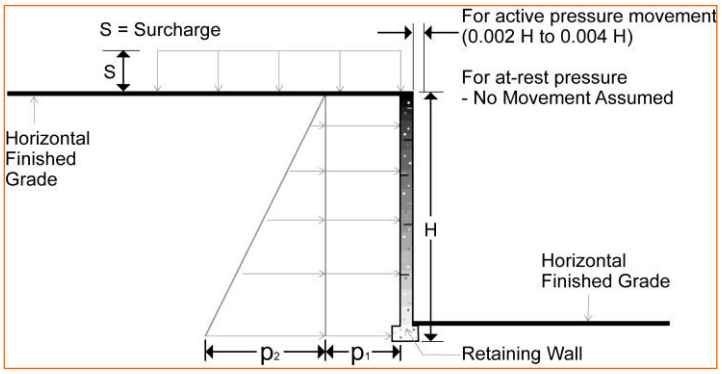


OVER-EXCAVATION / BACKFILL DETAIL
D - Depth of over-excavation beneath foundations

LATERAL EARTH PRESSURES

Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).



Lateral Earth Pressure Design Parameters				
Earth Pressure Condition [1]	**Coefficient for Backfill Type** [2]	**Surcharge Pressure** [3, 4, 5] **p_1 (psf)**	**Effective Fluid Pressures (psf)** [2, 4, 5]	
			Unsaturated [6]	**Submerged** [6]
Active (K_a)	0.30	(0.30)S	(40)H	---
At-Rest (K_o)	0.47	(0.47)S	(62)H	---
Passive (K_p)	3.26	---	(430)H	---

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance.
2. Uniform, horizontal backfill using on-site material, compacted to at least 90 percent of the ASTM D 1557 maximum dry density, rendering a maximum unit weight of 114 pcf.
3. Uniform surcharge, where S (psf) is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. No safety factor is included in these values.
6. In order to achieve "Unsaturated" conditions, follow guidelines in **Subsurface Drainage for Below Grade Walls** below. "Submerged" conditions are recommended when drainage behind walls is not incorporated into the design.

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively.

Subsurface Drainage for Below Grade Walls

Backfill behind retaining walls should consist of a soil of sufficient granularity that the backfill will properly drain. The granular soil should be classified per the USCS as GW, GP, SW, SP, SW-SM or SP-SM. Surface drainage should be provided to prevent ponding of water behind walls. A drainage system consisting of either or both of the following should be installed behind all retaining walls:

- A 4-inch-diameter perforated PVC (Schedule 40) pipe or equivalent at the base of the stem encased in 2 cubic feet of granular drain material per linear foot of pipe or

- Synthetic drains such as Enkadrain, Miradrain, Hydraway 300 or equivalent.

Perforations in the PVC pipe should be 3/8 inch in diameter and should be placed facing down. Granular drain material should be wrapped with filter cloth such as Mirafi 140 or equivalent to prevent clogging of the drains with fines. Walls should be waterproofed to prevent nuisance seepage and damage. Water should outlet to an approved drain.

SLABS-ON-GRADE

To provide adequate support, floor slabs (or concrete slabs-on-grade) should bear on compacted fills or competent native soils. The thickness of the slab-on-grade shall be determined by the designer based on the use and design requirements for the concrete slab-on-grade. For slabs bearing on compacted fill, the top 12 inches of soil should be compacted to 95 percent relative compaction. Finish-graded surfaces should be rolled to provide smooth and dense surfaces.

Slabs to receive moisture-sensitive coverings should be provided with a vapor retarder/barrier. We recommend that a vapor retarder/barrier be designed and constructed according to the American Concrete Institute 302.1R, Concrete Floor and Slab Construction, which addresses moisture vapor retarder/barrier construction. At a minimum, the vapor retarder/barrier should comply with ASTM E1745 and have a nominal thickness of at least 10 mils. The vapor retarder/barrier should be properly sealed, per the manufacturer's recommendations, and protected from punctures and other damage. Per the Portland Cement Association, for slabs with vapor-sensitive coverings, a layer of dry, granular material (sand), minimum of 4 inches thick, should be placed under the vapor retarder/barrier. For slabs in humidity-controlled areas, a layer of dry, granular material (sand), minimum of 4 inches thick, should be placed above the vapor retarder/barrier.

For the subject project, it is also acceptable to place the vapor barrier directly on the compacted soil and then place a layer of dry sand, minimum of 4 inches thick, on top of the vapor barrier.

A modulus of vertical subgrade reaction of 350 ksf/ft can be utilized in the design of slabs-on-grade for the proposed structures.

PAVEMENTS

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs, noted in this section, must be applied to the site, which has been prepared as recommended in the **Earthwork** section.

Pavement Design Parameters

Design of asphalt concrete (AC) pavements is based on the procedures outlined in the Caltrans "Highway Design Manual for Safety Roadside Rest Areas" (Caltrans, 2016). Design of Portland cement concrete (PCC) pavements are based upon American Concrete Institute (ACI) 330R-08; "Guide for Design and Construction of Concrete Parking Lots."

R-value tests were performed on samples mixed from near surface bulk samples from boring Nos. B-9 thru B-11 from graded area (Mixture 1) and B-12 from non-graded area (Mixture 2). Additional R-value bulk samples were obtained (RV-1 thru RV-4 from graded area and RV-5 from non-graded area). Our visual classifications indicate that Mixture 1 is generally identical with mixture from RV-1 thru RV-4 samples and Mixture 2 is identical with RV-5. Test result indicates R-values of 37 (Exhibit C-7) and 32 (Exhibit C-8), respectively. R-values of 37 and 32 were used for the AC pavement and moduli of subgrade reaction of 145 and 161 pound per cubic inch (pci) for PCC pavement designs. A modulus of rupture of 600 psi was used for pavement concrete. The structural sections are predicated upon proper compaction of the utility trench backfills and the subgrade soils as prescribed by in **Earthwork**, with the upper 12 inches of subgrade soils and all aggregate base material brought to a minimum relative compaction of 95 percent in accordance with ASTM D1557 prior to paving. The aggregate base should meet Caltrans requirements for Class 2 base.

It should be noted that the pavement designs were based upon the results of preliminary sampling and testing and should be verified by additional sampling and testing during construction when the actual subgrade soils are exposed.

Pavement Section Thicknesses

The following table provides options for AC and PCC Sections for graded area:

Asphaltic Concrete Design			
Usage	**Traffic Index**	**R-Value**	**Recommended Structural Section**
Auto Parking Areas	5.0	37	0.25' HMA[1]/0.35' Class 2 AB[2]
Auto Roads	5.5	37	0.25' HMA[1]/0.50' Class 2 AB[2]
Truck Parking Areas	6.0	37	0.30' HMA[1]/0.50' Class 2 AB[2]
Truck Ramps and Roads	8.0	37	0.40' HMA[1]/0.75' Class 2 AB[2]

1. HMA = hot mix asphalt
2. AB = aggregate base

Portland Cement Concrete Design			
Layer	**Thickness (inches)**		
	Light Duty[1]	**Medium Duty[2]**	**Dumpster Pad[3]**
PCC	4.5	5.5	7.0
Aggregate Base [4]	--	--	--

1. Car Parking and Access Lanes, Average Daily Truck Traffic (ADTT) = 1 (Category A).
2. Truck Parking Areas, Multiple Units, ADTT = 25 (Category B)
3. In areas of anticipated heavy traffic, fire trucks, delivery trucks, or concentrated loads (e.g., dumpster pads), and areas with repeated turning or maneuvering of heavy vehicles, ADTT = 700 (Category C).
4. Aggregate base is not required. Compacted on-site material is considered competent.

The following table provides options for AC and PCC Sections for non-graded area:

Asphaltic Concrete Design			
Usage	**Traffic Index**	**R-Value**	**Recommended Structural Section**
Auto Parking Areas	5.0	32	0.25' HMA[1]/0.45' Class 2 AB[2]
Auto Roads	5.5	32	0.25' HMA[1]/0.55' Class 2 AB[2]
Truck Parking Areas	6.0	32	0.30' HMA[1]/0.60' Class 2 AB[2]
Truck Ramps and Roads	8.0	32	0.40' HMA[1]/0.90' Class 2 AB[2]

3. HMA = hot mix asphalt
4. AB = aggregate base

Portland Cement Concrete Design			
Layer	Thickness (inches)		
	Light Duty[1]	Medium Duty[2]	Dumpster Pad[3]
PCC	4.5	5.5	7.0
Aggregate Base [4]	--	--	--

5. Car Parking and Access Lanes, Average Daily Truck Traffic (ADTT) = 1 (Category A).
6. Truck Parking Areas, Multiple Units, ADTT = 25 (Category B)
7. In areas of anticipated heavy traffic, fire trucks, delivery trucks, or concentrated loads (e.g., dumpster pads), and areas with repeated turning or maneuvering of heavy vehicles, ADTT = 700 (Category C).
8. Aggregate base is not required. Compacted on-site material is considered competent.

Recommended structural sections were calculated based on assumed TIs and our preliminary sampling and testing. For other TIs, the structural sections provided in Exhibits C-9 and C-10 should provide satisfactory AC pavement.

Terracon does not practice traffic engineering. We recommend that the project civil engineer or traffic engineer verify that the TIs and ADTT traffic indices used are appropriate for this project.

Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

EARTHWORK

Earthwork will include clearing and grubbing, excavations and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria as necessary to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

General Site Grading

It is imperative that no grading operations including subexcavation and backfill recompaction be performed without the presence of a representative of the geotechnical engineer. An on-site, pre-job meeting with the developer, the contractor and the geotechnical engineer should occur prior to all grading-related operations. Observation, testing, documenting and reporting of the grading operation should be performed by the geotechnical engineer of record. A final compaction report should be issued by the geotechnical engineer of record at the completion of the grading operation. Operations undertaken at the site without the geotechnical engineer present may result in exclusions of affected areas from the final compaction report for the project.

Grading of the subject site should be performed, at a minimum, in accordance with these recommendations and with applicable portions of the CBC. The following recommendations are presented for your assistance in establishing proper grading criteria.

Initial Site Preparation

All areas to be graded should be stripped of significant vegetation and other deleterious materials. These materials should be removed from the site for disposal. Any existing utility lines should be traced, removed and rerouted from the structural areas.

Any existing undocumented fills and loose native materials encountered during grading should be completely removed from all areas to be graded and cleaned of significant deleterious materials; they may be reused as compacted fill.

To assist in identification and removal of undocumented fill and/or loose native soil, it is our opinion that all areas to be graded should be subexcavated to a minimum depth of 12 inches bgs. The undocumented fill and local, loose, native soil should be completely removed and recompacted. The maximum removal depth could be on order of *5 feet* bgs or deeper. A relative compaction of *at least 85 percent* may be utilized as a preliminary quantitative criterion to supplement the engineering geologist's qualitative evaluation of the suitable base of the excavation. An engineering geologist from this firm should be present during the subexcavation operation prior to scarification and refilling in order to identify existing fills or loose soils extending below this depth. The bottoms of all excavations should be observed and approved by the engineering geologist.

Preparation of Fill Areas

The bottoms of the excavations should be observed by the engineering geologist to verify the complete removal of undocumented fill material and loose/disturbed native soils. Following approval, the bottoms should be scarified to a depth of approximately 6 inches, brought to near optimum moisture content and recompacted to at least 93 percent relative compaction (ASTM D1557).

Overexcavation For Structure Areas

The structure type, size and layout are not available at the time of this investigation. The topographic information before and after grading should be filed and available for future planning.

Footings for any structures should not be allowed to span from cut to fill or from shallow fill to deep fill soil conditions. Should grading result in a situation where footings bear on more than 8 feet of compacted fill, such as along transition areas and canyons, the subexcavation of the building pad should be deepened as necessary so as to provide a uniform fill mat below bottom of footing. This deepening of the subexcavation will involve additional removals of older alluvium or bedrock. The uniform fill mat should not vary in thickness from one side of the building pad area to the other by more than 50 percent, 10 feet maximum. The "building pad area" includes

the structure footprint and the zone of influence consisting of a 1(h):1(v) downward projection from the structure footing.

Preparation of Footing Areas

All footings should rest entirely upon competent native soils or minimum of 12 inches of properly compacted fill material. This subexcavation should extend at least 2 feet laterally beyond the footing lines, where possible. The bottoms of all excavations should be observed and approved by an engineering geologist from this firm. Upon the approval of the excavation bottom by geologist, the bottom of this excavation should then be scarified to a depth of approximate 6 inches, brought to near optimum moisture content, and recompacted to a minimum of 93 percent relative compaction in accordance with ASTM D1557 prior to refilling the excavation to the required grade as properly compacted fill.

Foundation concrete should be placed in neat excavations with vertical sides, or the concrete should be formed and the excavations properly backfilled as recommended for compacted fill.

Compacted Fills

The on-site soils should provide adequate quality fill material, provided they are free from roots, other organic matter and deleterious materials. Unless approved by the geotechnical engineer, rock or similar irreducible material with a maximum dimension greater than 6 inches should not be buried or placed within the top 10 feet of fills.

Import fill should be inorganic, non-expansive, granular soil free from rocks or lumps greater than 6 inches in maximum dimension. The contractor shall notify the geotechnical engineer of import sources sufficiently ahead of their use so that the sources can be observed and approved as to the physical characteristic of the import material. For all import material, the contractor shall also submit current verified reports from a recognized analytical laboratory indicating that the import has a "not applicable" (Class S0) potential for sulfate attack based upon current American Concrete Institute (ACI) criteria and is not corrosive to ferrous metal and copper. The reports shall be accompanied by a written statement from the contractor that the laboratory test results are representative of all import material that will be brought to the job.

Fill should be spread in near-horizontal layers, approximately 8 inches in thickness. Thicker lifts may be approved by the geotechnical engineer if testing indicates that the grading procedures are adequate to achieve the required compaction. Each lift should be spread evenly, thoroughly mixed during spreading to attain uniformity of the material and moisture in each layer, brought to at least optimum moisture content and compacted to a minimum relative compaction of 93 percent in accordance with the current version of ASTM D1557. Fills deeper than 5 feet in vertical extent should be compacted to a minimum of 95 percent relative compaction.

Shrinkage

Based upon the relative compaction of the native soils tested during this investigation and the relative compaction anticipated for compacted fill soils, we estimate compaction shrinkage of approximately 5 to 15 percent. Therefore, 1.05 to 1.15 cubic yards of in-place soil material would be necessary to yield 1 cubic yard of properly compacted fill material. These values are exclusive of losses due to stripping, tree removal or the removal of other subsurface obstructions, if encountered, and may vary due to differing conditions within the project boundaries and the limitations of this investigation.

Values presented for shrinkage are estimates only. Contractors should make their own investigations and estimates of shrinkage. Final grades should be adjusted and/or contingency plans to import or export material should be made to accommodate possible variations in actual quantities during site grading.

It is crucial that the geotechnical engineer be present to observe these operations. Further recommendations may be made in the field, depending on the actual conditions encountered.

Rippability

Two hills consisting primarily of metamorphic bedrock were removed during grading of the Nichols Road grading project, located in the northern portion of the site. Difficulty in ripping of the larger, western hill was encountered during grading. Jack hammering of hard marble exposures in this area was ongoing during this investigation. The grading in progress on the Nichols Road grading project is currently intended to provide mass graded commercial pads with minor undercut from rough grade pad elevations. Future development may require additional cutting and/or excavation such as utility and footing trenches in the bedrock area. Portions will encounter non-rippable bedrock with a D-9 and bedrock that is non-trenchable with large excavators. Oversize rock has already been generated, reduced in size when necessary, and transported to the Nichols Road quarry to the north.

The Nichols Road grading project is intended to reach mass grade elevations only. When final development plans are available, a seismic refraction (rippability/excavation potential) investigation should be conducted to better determine the rippability and trenchability conditions for the proposed development.

Oversized Material

It is anticipated that significant quantities of oversized material (boulders larger than 12 inches and portions of concrete structures from possible demolition work) requiring special handling for disposal may be generated during the grading operation. While site-specific recommendations may be developed during the grading plan preparation or in the field during construction, we are providing general methods for disposing of oversized rock and concrete on site for preliminary

consideration.

Materials between approximately 12 and 48 inches in size may be placed in areas of fill depth greater than approximately 20 feet below finish grade with the approval of the building official. Areas should be designated on plans as rock disposal areas.

The oversized rock should be placed in windrows and adequately spaced to prevent nesting. Then, sandy matrix material should be flooded between the rocks to fill any void spaces. Continuous observation of the rock placement and flooding operation should be conducted by the geotechnical engineer.

Again, these recommendations are preliminary. Further recommendations may be made in the field depending on the actual conditions encountered.

Settlement Monitoring

Although not anticipated, if grading results in fills greater than 40 feet deep, such fills should be monitored for settlement. To verify substantial completion of compression of the fill, an initial reading of the settlement monitors should be taken immediately after construction. The fill should then be monitored at least four additional times at an interval determined by this firm for both horizontal and vertical movement. The criteria for a determination of the completion of significant settlement will be established by this firm after analysis of at least five readings. A typical settlement monitor detail is included as Enclosure "E-1" in **Previous Exploration Results** section. Location and installation of settlement monitors should be performed immediately after construction. Settlement monitors should be clearly marked and readily visible (red flagged) to avoid disturbance. Clearance should be maintained from heavy equipment operations.

Grading and Drainage

All grades must provide effective drainage away from the buildings during and after construction and should be maintained throughout the life of the structures. Water retained next to the buildings can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roofs should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the buildings.

We recommend a minimum horizontal setback distance of 10 feet from the perimeter of any building and the high-water elevation of the nearest storm-water retention basin.

Portions of Stovepipe Wash include steep and high slopes. The southwesterly portion of the wash includes existing slopes up to approximately 25 feet in height and relatively steep (1 horizontal to 1 vertical and locally steeper). Setbacks for structures should be maintained from the steep

slopes in Stovepipe Wash. We recommended that a minimum horizontal distance equivalent to 1.5 times the height of the slope be maintained for all structures from the top of the slope. The term structures as used here includes human occupancy structures (residential and commercial) as well as pools and gazebos. This recommendation is intended to apply to a static condition in Stovepipe Wash for the lifetime of the proposed structures. If significant erosion/scour is expected to occur along Stovepipe Wash, greater setbacks could be necessary. An evaluation of the future erosion/scour potential along Stovepipe Wash falls under the purview of the project hydrological professionals.

Exposed ground should be sloped and maintained at a minimum 3 percent away from the buildings for at least 10 feet beyond the perimeter of the buildings. Locally, flatter grades may be necessary to transition to ADA access requirements for flatwork. After building construction and landscaping, final grades should be verified to document effective drainage has been achieved. Grades around the structures should also be periodically inspected and adjusted as necessary as part of the structures' maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

Shallow excavations, for the proposed building structures, are anticipated to be accomplished with conventional construction equipment except for the area of hard bedrock in the west portion of the Nichols Road grading project (discussed in the Rippability section of this report). Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over, or adjacent to, construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted, prior to floor slab or pavement construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the geotechnical engineer. Monitoring should include documentation of adequate removal of vegetation and top soil, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the geotechnical engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the structure areas and 5,000 square feet in pavement areas. One density and water content test should be performed for each 1-foot of backfill, for every 250 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the geotechnical engineer. In the event unanticipated conditions are encountered, the geotechnical engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the geotechnical engineer into the construction phase of the project enables the geotechnical engineer to evaluate subsurface conditions, including assessing variations and associated design changes.

CORROSIVITY

Selected samples of materials were delivered to HDR, Inc. for preliminary soil corrosivity testing. Laboratory testing consisted of pH, resistivity and major soluble salts commonly found in soils. The results of the laboratory tests performed by HDR, Inc. appear in Exhibit C-6.

These tests have been performed to screen the site for potentially corrosive soils. Values from the soil tested are considered potentially "mildly corrosive" and "moderately corrosive" to ferrous metals both at as-received condition and saturated conditions, respectively. Specific corrosion control measures, such as coating of the pipe with non-corrosive material or alternative non-metallic pipe material, will be needed if there is a potential of soil saturation.

Ammonium and nitrate levels did not indicate a concern as to corrosion of buried copper.

Results of the soluble sulfate testing indicate a "not applicable" (Class S0) anticipated exposure to sulfate attack. Based on the criteria from Table 4.3.1. of the American Concrete Institute "Manual of Concrete Practice" (2011), no special measures, such as specific cement types or water-cement ratios, will be needed for this "not applicable" exposure to sulfate attack.

The soluble chloride content of the soils tested was not at levels high enough to be of concern with respect to corrosion of reinforcing steel. The results should be considered in combination with the soluble chloride content of the hardened concrete in determining the effect of chloride on the corrosion of reinforcing steel.

Terracon does not practice corrosion engineering. If further information concerning the corrosion characteristics, or interpretation of the results submitted herein, is required, then a competent corrosion engineer could be consulted.

STORMWATER MANAGEMENT

Preliminary percolation tests were performed following the procedures described in Shallow Percolation Test (less than 10 feet), Section 2.3, of Riverside County LID BMP. Five-gallon water bottles were used. The soil at the percolation test locations was classified in the field using a visual/manual procedure. The infiltration velocity is presented as the infiltration rate corrected for rock backfill, if used, and is summarized in the following table. The infiltration rates provided do not include safety factors.

Test Boring	Test	Test Depth (ft)[1]	Soil Type	Infiltration Rate[2]	
				in./hr.	cm./hr.
1	P-1	10	SM	0.51	1.3
2	P-2	10	SM	0.59	1.5
3	P-3	6	SM	0.47	1.2
	P-4	9	SM	0.64	1.6

1. Below existing ground surface
2. Corrected for rock backfill, if used

The above infiltration rates determined by the shallow percolation test method are based on field test results utilizing clear water. Infiltration rates can be affected by silt buildup, debris, degree of soil saturation, site variability and other factors. The rate obtained at a specific location and depth is representative of the location and depth tested and may not be representative of the entire site. Based on the test results, a measured infiltration rate of 0.5 in./hr. is recommended to be used in the design of a detention basin, provided an appropriate safety factor is applied to this value. Application of an appropriate safety factor is prudent to account for subsoil inconsistencies,

possible compaction related to site grading, and potential silting of the percolating soils, depending on the application.

The design engineer should also check with the local agency for the limitation of the infiltration rate allowed in the design. If the maximum allowable design infiltration rate is lower than the above recommended rate, the maximum allowable design infiltration rate should be used. The designer of the basins should also consider other possible site variability in the design.

The above percolation tests should be considered as preliminary. At the time that the locations and depths of detention basins are determined, additional percolation tests may be needed. The designer should confirm with Riverside County for the requirements of additional tests.

The results of the previous double-ring infiltration testing are presented below. These test locations are indicated in yellow as P-1 through P-4 on the **Exploration Plan**. For a description of the double-ring infiltrometer method, see the report by CHJ Consultants, a Terracon Company, Project No. 17110-2 dated March 31, 2017.

Test Excavation	Test	Test Depth (ft)[3]	Soil Type	Infiltration Rate	
				in./hr.	cm./hr.
1	P-1	0.5	SM	0.1	0.3
2	P-2	1.5	SM	0.1	0.3
3	P-3	3.0	SM	0.2	0.4
4	P-4	2.0	SM	0.1	0.3

3. Below existing ground surface

GENERAL COMMENTS

As the project progresses, we address assumptions by incorporating information provided by the design team, if any. Revised project information that reflects actual conditions important to our services is reflected in the final report. The design team should collaborate with Terracon to confirm these assumptions and to prepare the final design plans and specifications. This facilitates the incorporation of our opinions related to implementation of our geotechnical recommendations. Any information conveyed prior to the final report is for informational purposes only and should not be considered or used for decision-making purposes.

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to

provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

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ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Previous Field Exploration

Number of Borings [1]	Planned Boring Depth (feet) [2]	Location
8	25.5 to 51.5	North portion of the track See **Exploration Plan**

1. Drilled on May 2016 (CHJ Job No. 16164-3)
2. Below ground surface

Number of Double-Ring Infiltrometer Tests[3]	Test Depth (feet) [4]	Location
4	0.5 to 3.0	Proposed basin locations in southern portion of graded property See **Exploration Plan**

3. Excavated on March 24, 2017 (CHJ, a Terracon Company, Project No. 17110-2)
4. Below ground surface

Current Field Exploration

Number of Borings	Planned Boring Depth (feet) [1]	Location [2]
8 Borings	20.2 to 51.5	Planned residential and hotel areas See **Exploration Plan**
4 Borings	5.0 to 10.0	Street improvements See **Exploration Plan**
5 Surface Samples	0 to 2	Street improvements See **Exploration Plan**

1. Below ground surface
2. See **Exploration Plan**

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provide the boring layout. Coordinates are obtained with a handheld GPS unit (estimated horizontal accuracy of about ±20 feet). If a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We advance the borings with a truck-mounted drill rig using hollow stem augers. Both a standard penetration test (SPT) sampler (2-inch outer diameter and 1-3/8-inch inner diameter) and a modified California ring-lined sampler (3-inch outer diameter and 2-

3/8-inch inner diameter) are utilized in our investigation. The penetration resistance is recorded on the boring logs as the number of hammer blows used to advance the sampler in 6-inch increments (or less if noted). The samplers are driven with an automatic hammer that drops a 140-pound weight 30 inches for each blow. After the required seating, samplers are advanced up to 18 inches, providing up to three sets of blowcounts at each sampling interval. The sampling depths, penetration distances, and other sampling information are recorded on the field boring logs. The recorded blows are raw numbers without any corrections for hammer type (automatic vs. manual cathead) or sampler size (ring sampler vs. SPT sampler). Relatively undisturbed and bulk samples of the soils encountered are placed in sealed containers and returned to the laboratory for testing and evaluation.

We observe and record groundwater levels during drilling and sampling. For safety purposes, all borings are backfilled with auger cuttings after their completion. Pavements, if encountered, are patched with cold-mix asphalt and/or pre-mixed concrete, as appropriate.

Our exploration team prepares field boring logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs are prepared from the field logs. The final boring logs represent the geotechnical engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviews the field data and assigns various laboratory tests to better understand the engineering properties of the various soil strata as necessary for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods are applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil by Mass
- ASTM D7263 Standard Test Methods for Laboratory Determination of Density (Unit Weight) of Soil Specimens
- ASTM D6913 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- ASTM D1140 Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing
- ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
- ASTM D4546 Standard Test Methods for One-Dimensional Swell or Collapse of Soils

- ASTM D3080/D3080M Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions
- ASTM D2419 Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
- ASTM D2844 Standard Test Method for Resistance R-Value and Expansion Pressure of Compacted Soils
- Soil Resistivity and chemical analysis per ASTM G187, ASTM D6919, ASTM D4327, and APHA 2320-B, etc.

The laboratory testing program often includes examination of soil samples by an engineer. Based on the material's texture and plasticity, we describe and classify the soil samples in accordance with the Unified Soil Classification System.

Percolation Tests

The field percolation test program consists of the following:

Number of Test Borings	Number of Tests	Test Depth (ft)[1]	Location
3	3	4 to 10	See **Exploration Plan**

1. Below existing ground surface (bgs)

Tests are performed in accordance with Shallow Percolation Test (less than 10 feet) procedures described in Section 2.3 of Riverside County – "Design Handbook for Low Impact Development Best Management Practices (LID BMP)". LID BMP requires four tests minimum with at least two per BMP location. LID BMP also requires that the soils located at a depth of 10 feet below the proposed basin bottom be explored in order to ensure that a non-permeable soil or rock layer is not present. We utilize the soil boring data from this investigation to satisfy this requirement.

The detailed procedures are described in Shallow Percolation Test (less than 10 feet) of Section 2.3, of Riverside County LID BMP.

SITE LOCATION AND EXPLORATION PLANS

SITE LOCATION MAP

Tentative Tract No. 37305 ■ Lake Elsinore, CA
January 24, 2018 ■ Terracon Project No. CB175281

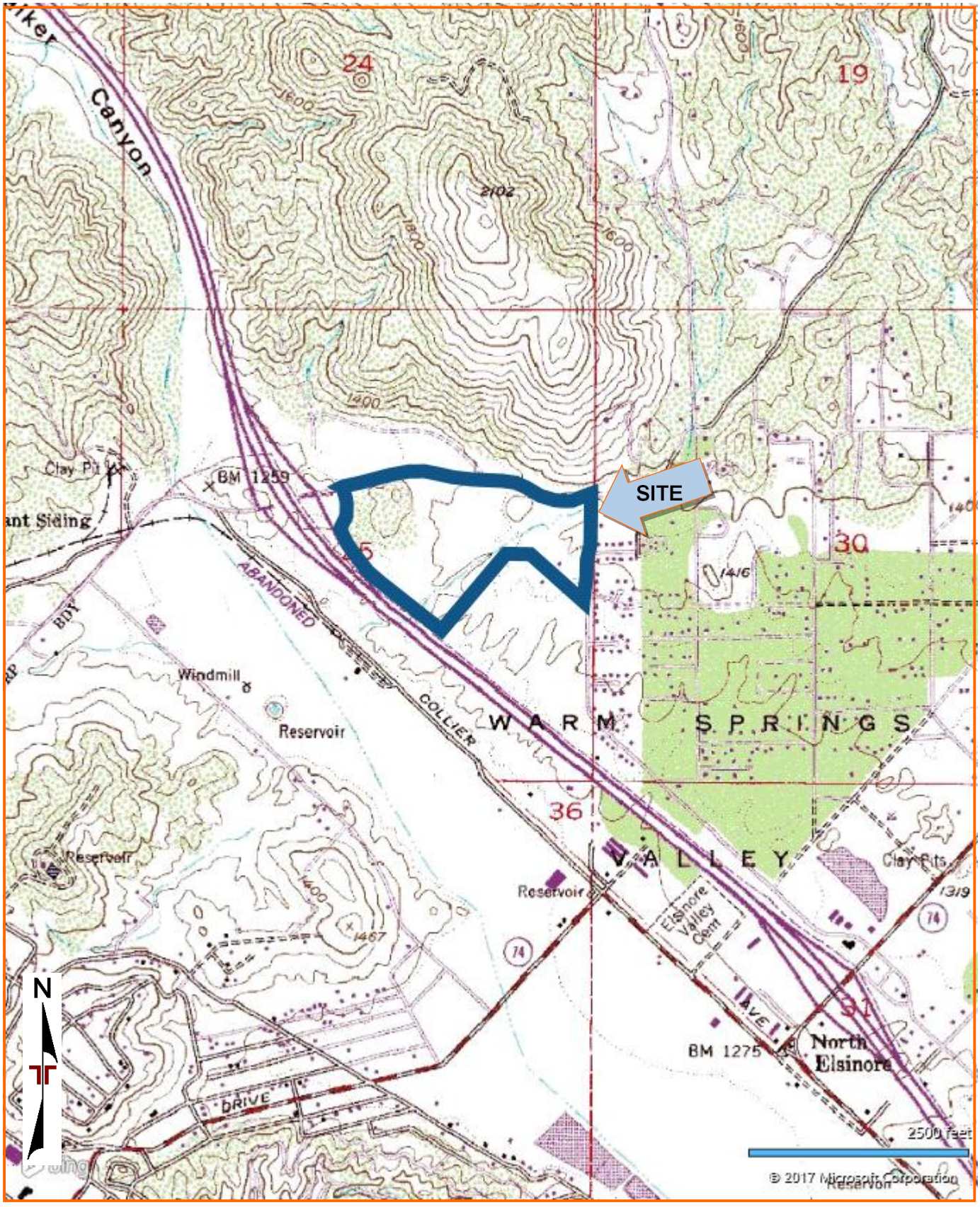


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

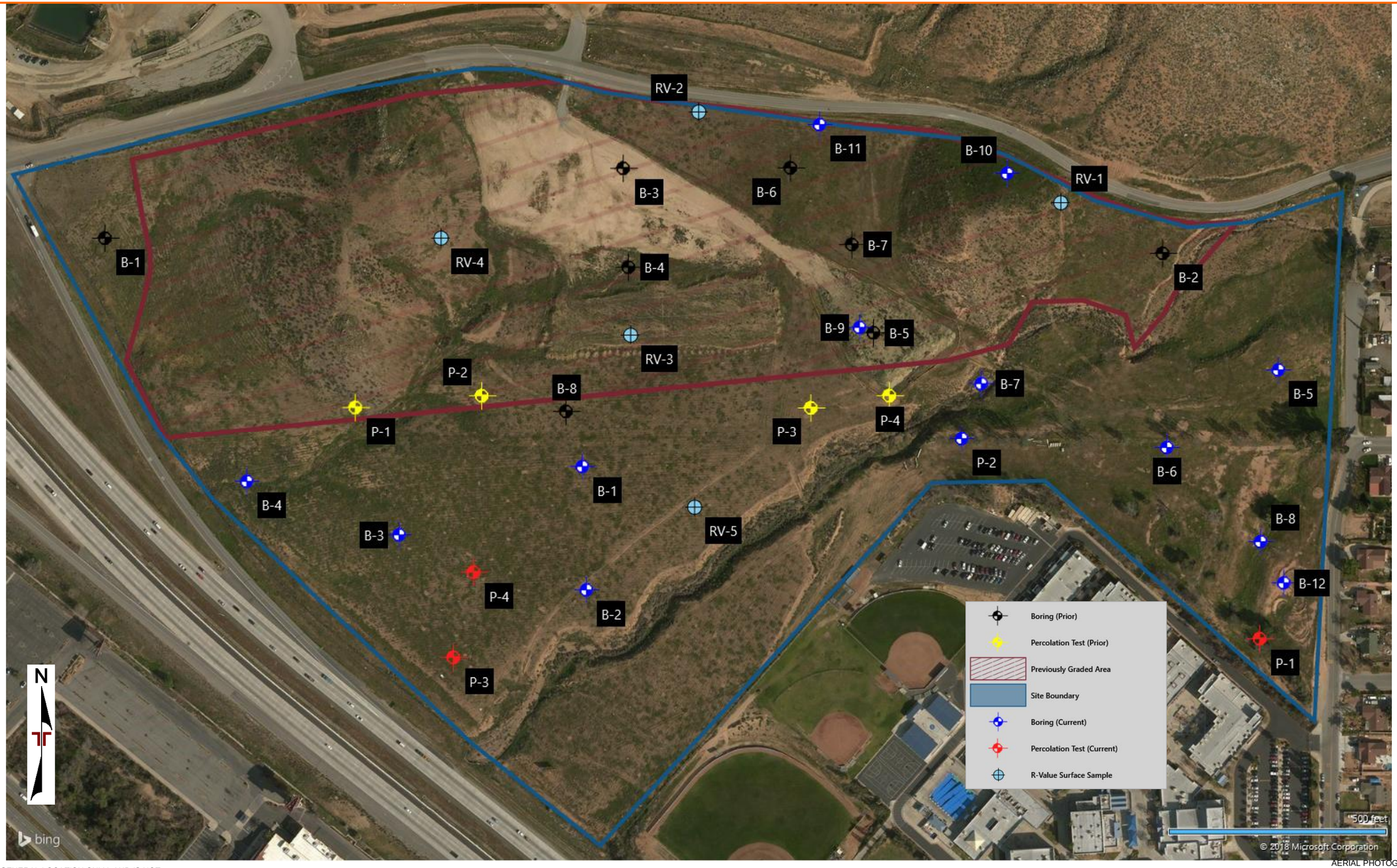


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

BORING LOG NO. B-1

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

LOCATION See Exploration Plan

Latitude: 33.7055° Longitude: -117.3524°

DEPTH	GRAPHIC LOG		WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
		SANDY SILT WITH GRAVEL (ML), fine to medium grained, light brown, gravel to 1" maximum diameter						
					44-50/2"	4	108	
						5		
5					50/6"	5	115	
10.0								
		SILTY SAND WITH GRAVEL (SM), fine to coarse grained, brown, gravel to 1" maximum diameter						
10					27-30-50/6"	2	116	
						4		
15					21-32-40	3	116	
20					30-41-50/3"	5	116	
25					20-21-26	4	115	
26.5		***Boring Terminated at 26.5 Feet***						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

Auger samples combined from B-1 and B-3.

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon

1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

BORING LOG NO. B-2

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

SITE:

CLIENT: Nichols Road Partners Corona, CA

LOCATION See Exploration Plan

Latitude: 33.7047° Longitude: -117.3524°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
		SILTY SAND (SM), fine to coarse grained, brown							
						16-22-23 N=45			
							3		36
5.0		**SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, brown, gravel to 1" maximum diameter	5			19-16-17 N=33			
			10			12-14-11 N=25			
							3		
			15			11-14-18 N=32			26
			20			9-12-13 N=25			
			25			8-8-9 N=17			43

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./2.0" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

BORING LOG NO. B-2

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

LOCATION See Exploration Plan

Latitude: 33.7047° Longitude: -117.3524°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
		SILTY SAND WITH GRAVEL (SM), fine to coarse grained, brown, gravel to 1" maximum diameter *(continued)*							
			30		X	6-8-9 N=17			
			35		X	14-23-18 N=41			
36.0		**SILT WITH SAND (ML)**, fine grained, dark brown, tight driling							
			40		X	7-12-17 N=29			
			45		X	7-14-14 N=28			
50.0		**SILTY SAND (SM)**, fine to coarse grained, brown	50		X	14-36-30 N=66			
51.5		***Boring Terminated at 51.5 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./2.0" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

BORING LOG NO. B-3

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

LOCATION See Exploration Plan

Latitude: 33.705° Longitude: -117.3538°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
		SANDY SILT (ML), fine to medium grained, light brown							
						32-50/3"	4	105	
							3		
			5			50/6"	6		
10.0									
		SILTY SAND WITH GRAVEL (SM), fine to medium grained, brown, gravel to 1" maximum diameter	10			14-30-39	3	114	
							4		
			15			15-41-50/5"	7	117	
			20			22-50/5"	6	126	
			25			8-13-21	12	116	
26.5									
		Boring Terminated at 26.5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

BORING LOG NO. B-4

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

LOCATION See Exploration Plan

Latitude: 33.7054° Longitude: -117.355°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
		SANDY SILT WITH GRAVEL (ML), fine to medium grained, brown, gravel to 1" maximum diameter							
						6-14-18 N=32			
							5		
			5			9-12-16 N=28			
10.0		**SILT (ML)**, fine grained, brown	10			8-11-16 N=27			
							19		
			15			7-11-16 N=27			
			20			5-8-12 N=20			
			25			7-12-14 N=26			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./2.0" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

BORING LOG NO. B-4

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

LOCATION See Exploration Plan

Latitude: 33.7054° Longitude: -117.355°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
		SILT (ML), fine grained, brown *(continued)*							
31.0			30			7-12-16 N=28			
		METAMORPHIC BEDROCK, brown to gray, recovered as (ML) silt, with clay and sand (fine grained)	35			27-50/5"			
40.5			40			50			
		Boring Terminated at 40.5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic
Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./2.0" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

BORING LOG NO. B-5

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

SITE:

CLIENT: Nichols Road Partners Corona, CA

LOCATION See Exploration Plan

Latitude: 33.7061° Longitude: -117.3472°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
		SILTY SAND (SM), fine to coarse grained, light brown							
						50/5"	5	100	
							4		37
			5			50/6"	4	115	
10.0									
		METAMORPHIC BEDROCK, olive brown, highly weathered, recovered as (SM) Silty Sand with gravel, fine to coarse-grained, gravel to 1" maximum diameter	10			50/6"	10	113	
							7		
			15			50/4"	9		
20.3									
		Boring Terminated at 20.25 Feet	20			50/3"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

BORING LOG NO. B-6

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

LOCATION See Exploration Plan

Latitude: 33.7056° Longitude: -117.348°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
		SILTY SAND WITH GRAVEL (SM), fine to coarse grained, light brown, gravel to 1" maximum diameter							
						24-44-46 N=90			
							5		
5.0		**SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, light brown, gravel to 2" maximum diameter	5			14-17-15 N=32			
							4		
			10			10-16-20 N=36			
			15			21-27-41 N=68			
			20			17-20-22 N=42			
25.0		**SILTY SAND (SM)**, fine to medium grained, light yellowish brown, no gravel	25			20-26-23 N=49			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./2.0" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

BORING LOG NO. B-6

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

LOCATION See Exploration Plan

Latitude: 33.7056° Longitude: -117.348°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
		SILTY SAND (SM), fine to medium grained, light yellowish brown, no gravel *(continued)*							
30.0		**SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, light yellowish brown, gravel up to 2" maximum diameter	30		X	21-24-22 N=46			
			35		X	19-20-21 N=41			
40.0		**SILTY SAND (SM)**, fine to medium grained, light yellowish brown	40		X	17-22-27 N=49			
			45		X	18-24-22 N=46			
			50		X	17-25-25 N=50			
51.5		***Boring Terminated at 51.5 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./2.0" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

BORING LOG NO. B-7

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

SITE:

CLIENT: Nichols Road Partners
Corona, CA

LOCATION See Exploration Plan

Latitude: 33.706° Longitude: -117.3494°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
		SILTY SAND (ML), with clay, fine to medium grained, brown							
						23-23-22	4	107	
							6		
5.0			5						
		CLAYEY SAND (SC), fine to medium grained, brown				12-18-24	11		
							9		
10.0			10						
		METAMORPHIC BEDROCK (CL), with sand and gravel, recovered as (CL) with sand and gravel up to 1"				39-35-50	14	118	
			15			17-31-50/4"	23	106	
20.2			20			50/2"			
		Boring Terminated at 20.2 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic
Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

BORING LOG NO. B-8

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

LOCATION See Exploration Plan

Latitude: 33.705° Longitude: -117.3473°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
		SILTY SAND WITH GRAVEL (SM), fine to coarse grained, brown, gravel to 2" maximum diameter							
						10-8-6	19	103	
							10		
			5			7-11-13	11	117	
12.0									
		CLAYEY SAND (SC), fine to coarse grained, brown							
							11		
			10			13-18-20	12	119	
			15			15-21-30	10	127	
20.0									
		SILTY SAND (SM), with clay, fine to medium grained, brown	20			10-21-26	9	122	
25.0									
		SANDY SILT (ML), with clay, fine to medium grained, brown	25			10-14-18	10	123	
26.5									
		Boring Terminated at 26.5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

BORING LOG NO. B-9

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

LOCATION See Exploration Plan

Latitude: 33.7063° Longitude: -117.3503°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SILTY SAND WITH GRAVEL (SM), fine to coarse grained, brown, gravel to 2" maximum diameter					5		
	5.0	5						
	Boring Terminated at 5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

BORING LOG NO. B-10

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

LOCATION See Exploration Plan

Latitude: 33.7074° Longitude: -117.3491°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SILTY SAND WITH GRAVEL (SM), fine to coarse grained, brown, gravel to 2" maximum diameter					7		
	5.0	5						
	Boring Terminated at 5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

BORING LOG NO. B-11

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

LOCATION See Exploration Plan

Latitude: 33.7076° Longitude: -117.3506°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SILTY SAND WITH GRAVEL (SM), fine to coarse grained, brown, gravel to 2" maximum diameter					2		
	5.0	5						
	Boring Terminated at 5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

BORING LOG NO. B-12

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

LOCATION See Exploration Plan

Latitude: 33.7047° Longitude: -117.3471°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SILTY SAND (SM), fine to medium grained, light brown	5				5		
	10.0	10						
	Boring Terminated at 10 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

BORING LOG NO. P-1

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	LOCATION See Exploration Plan Latitude: 33.7044° Longitude: -117.3473°							
	SILTY SAND (SM), trace gravel, fine to medium grained, brown							
						9		32
	4.0							
	Boring Terminated at 4 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic
Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

BORING LOG NO. P-2

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 33.7056° Longitude: -117.3496° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SILTY SAND WITH GRAVEL (SM), fine to coarse grained, brown, gravel to 2" maximum diameter							
		5				5		27
	6.5 ***Boring Terminated at 6.5 Feet***							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic
Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

BORING LOG NO. P-3

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 33.7043° Longitude: -117.3534° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SILTY SAND WITH GRAVEL (SM), fine to coarse grained, brown, gravel to 2" maximum diameter	5						
	10.0					4		39
	Boring Terminated at 10 Feet	10						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic
Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

Boring Started: 01-02-2018 | Boring Completed: 01-02-2018

Drill Rig: CME 55 | Driller: 2R

Project No.: CB175281

BORING LOG NO. P-4

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

CLIENT: Nichols Road Partners Corona, CA

SITE:

LOCATION See Exploration Plan

Latitude: 33.7048° Longitude: -117.3532°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	PERCENT FINES
	SILTY SAND WITH GRAVEL (SM), fine to medium grained, gravel to 1" maximum diameter	5						
	9.0					5		37
	Boring Terminated at 9 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Hammer Weight/Drop Distance/Sampler Diameter: 140lbs./30in./3.25" O.D.

Advancement Method:
8" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1355 E Cooley Dr Ste C
Colton, CA

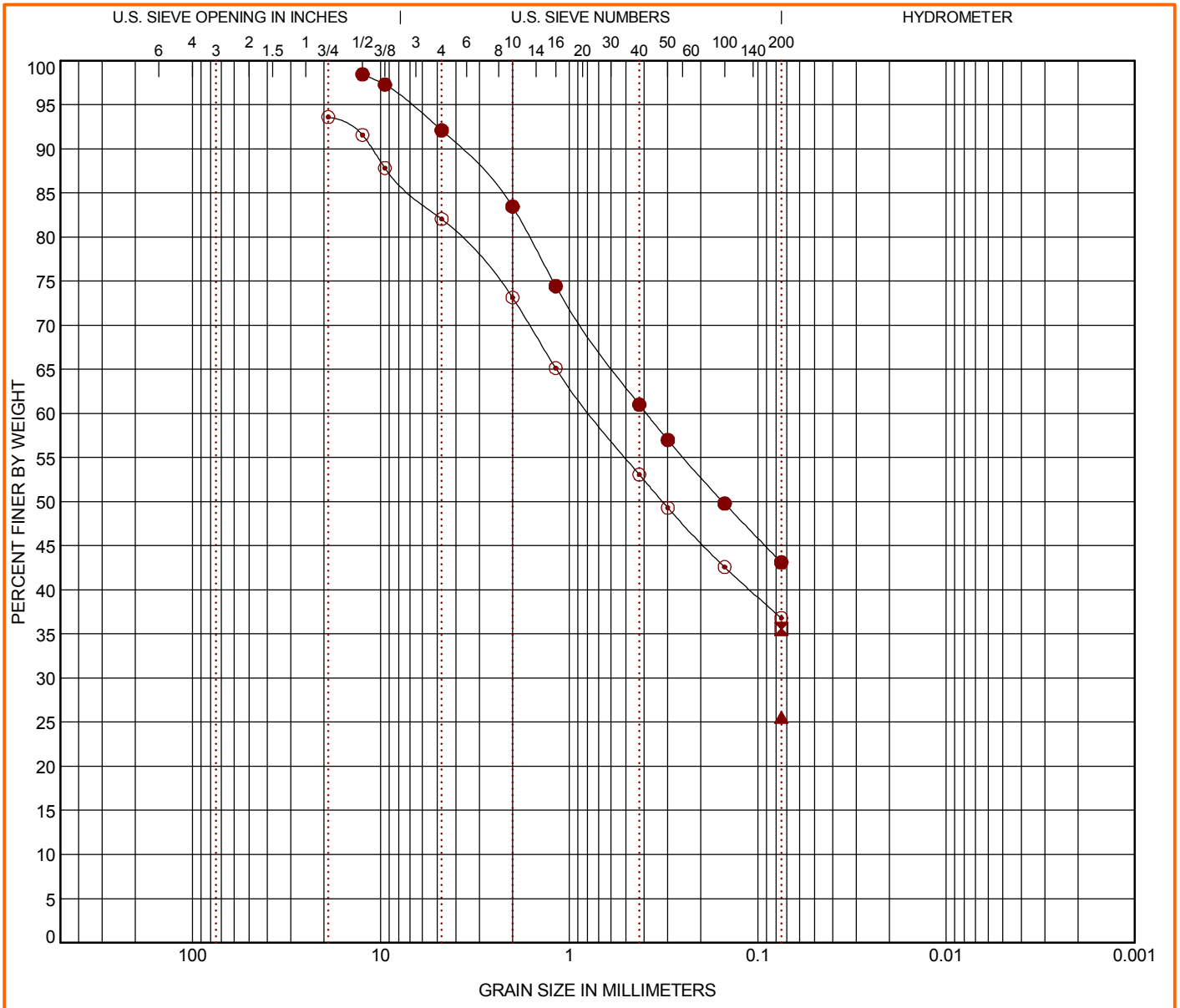
Boring Started: 01-11-2018 | Boring Completed: 01-11-2018

Drill Rig: CME 75 Track Rig | Driller: 2R

Project No.: CB175281

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
COMBINED SAMPLE 0 - 1		SILTY SAND (SM)		NP	NP	NP		
B-2	1.001 - 5		3					
B-2	10.002 - 20							
B-2	25 - 26.5							
B-5	1.001 - 5	SILTY SAND with GRAVEL (SM)	4	NP	NP	NP		

Boring ID	Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
COMBINED SAMPLE 0 - 1		12.5	0.39			6.4	49.0		43.1	
B-2	1.001 - 5	0.075				0.0	0.0		35.6	
B-2	10.002 - 20	0.075				0.0	0.0		25.6	
B-2	25 - 26.5	0.075				0.0	0.0		43.1	
B-5	1.001 - 5	19	0.764			11.6	45.2		36.8	

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

SITE:

Terracon
1355 E Cooley Dr Ste C
Colton, CA

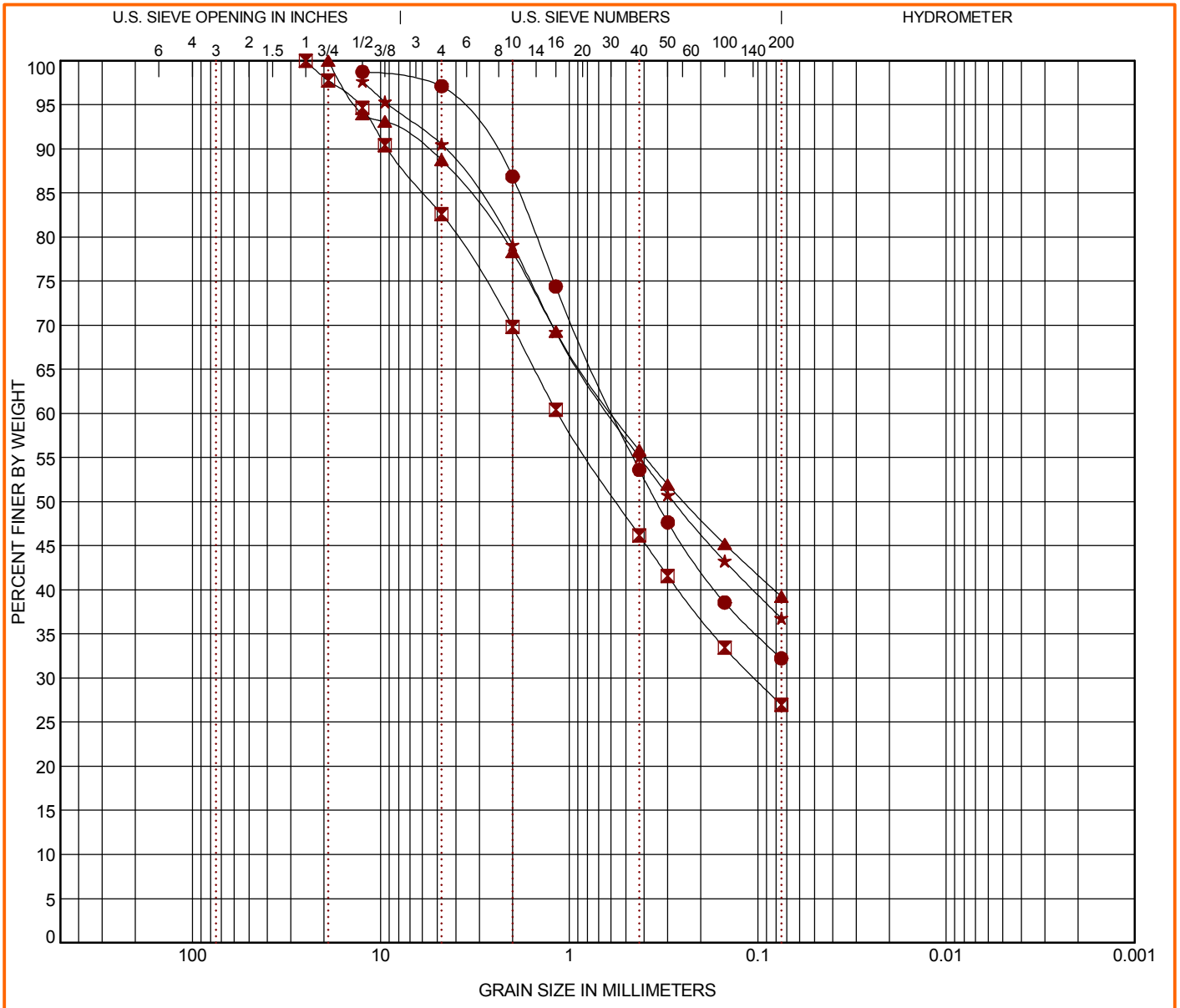
PROJECT NUMBER: CB175281

CLIENT: Nichols Road Partners
Corona, CA

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/19/18

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	P-1	2 - 4	SILTY SAND (SM)	9	NP	NP	NP		
⊠	P-2	4 - 6.5	SILTY SAND with GRAVEL (SM)	5	NP	NP	NP		
▲	P-3	8 - 10	SILTY SAND (SM)	4	NP	NP	NP		
★	P-4	7 - 9	SILTY SAND (SM)	5	NP	NP	NP		

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Gravel	%Sand	%Silt	%Fines	%Clay
●	P-1	2 - 4	12.5	0.582			1.6	64.9		32.2	
⊠	P-2	4 - 6.5	25	1.145	0.104		17.4	55.6		27.0	
▲	P-3	8 - 10	19	0.583			11.3	49.5		39.3	
★	P-4	7 - 9	12.5	0.606			7.2	53.7		36.8	

PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

SITE:

Terracon
1355 E Cooley Dr Ste C
Colton, CA

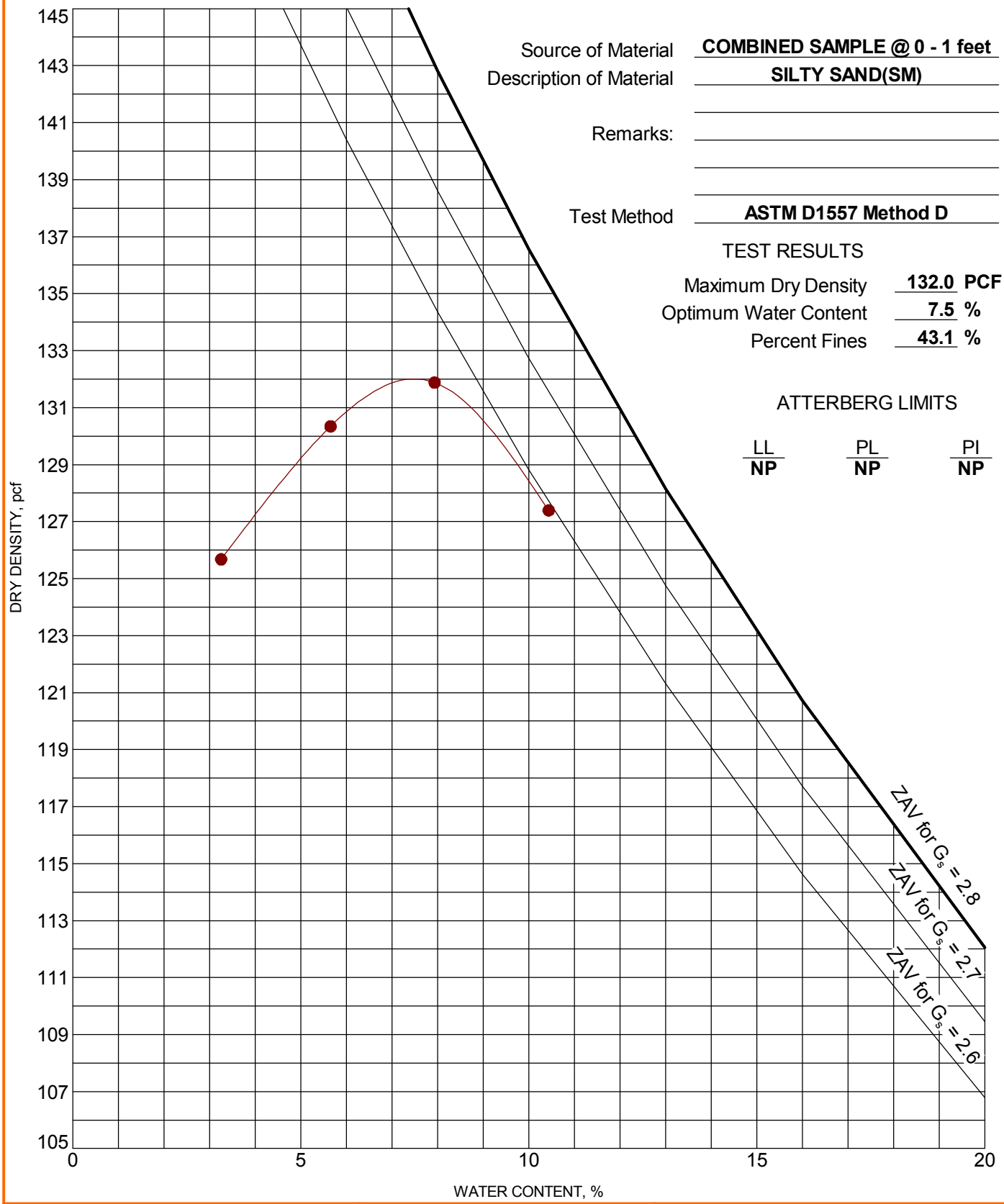
PROJECT NUMBER: CB175281

CLIENT: Nichols Road Partners
Corona, CA

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 CB175281 GEOTECHNICAL, INF.GPJ TERRACON_DATATEMPLATE.GDT 1/19/18

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material	**COMBINED SAMPLE @ 0 - 1 feet**
Description of Material	**SILTY SAND(SM)**
Remarks:	
Test Method	**ASTM D1557 Method D**

TEST RESULTS

Maximum Dry Density	**132.0 PCF**
Optimum Water Content	**7.5 %**
Percent Fines	**43.1 %**

ATTERBERG LIMITS

LL	PL	PI
NP	**NP**	**NP**

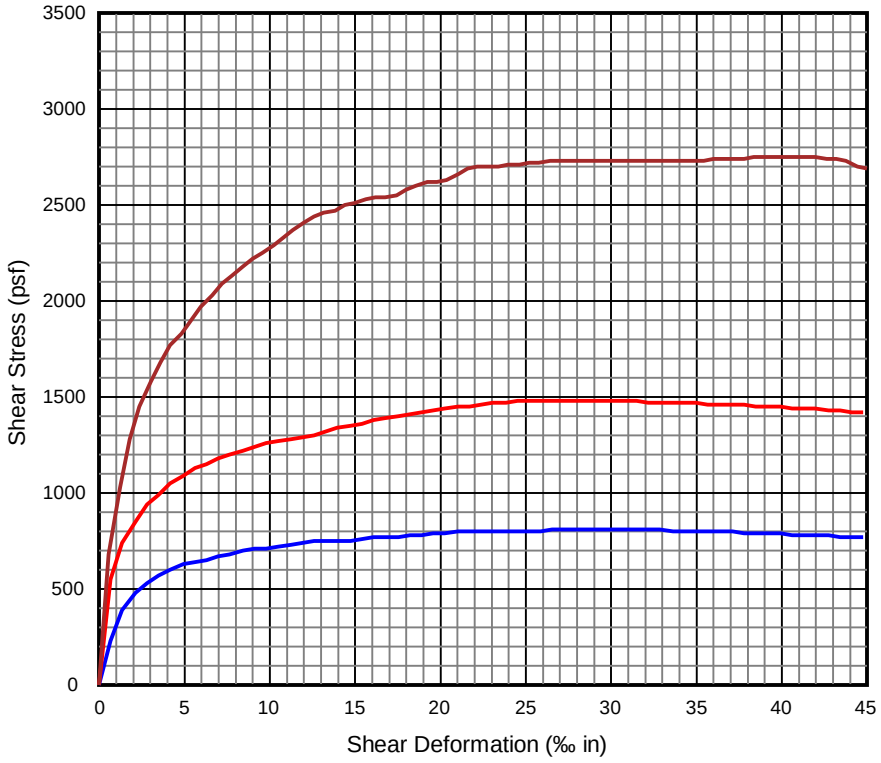
PROJECT: Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA

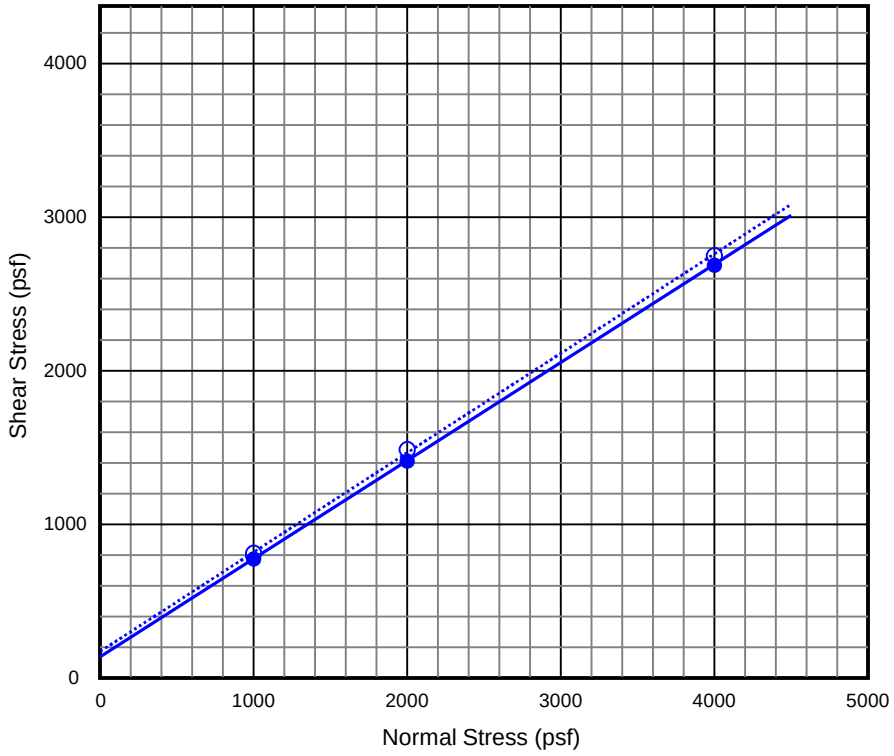
SITE:

Terracon
1355 E Cooley Dr Ste C
Colton, CA

PROJECT NUMBER: CB175281

CLIENT: Nichols Road Partners
Corona, CA





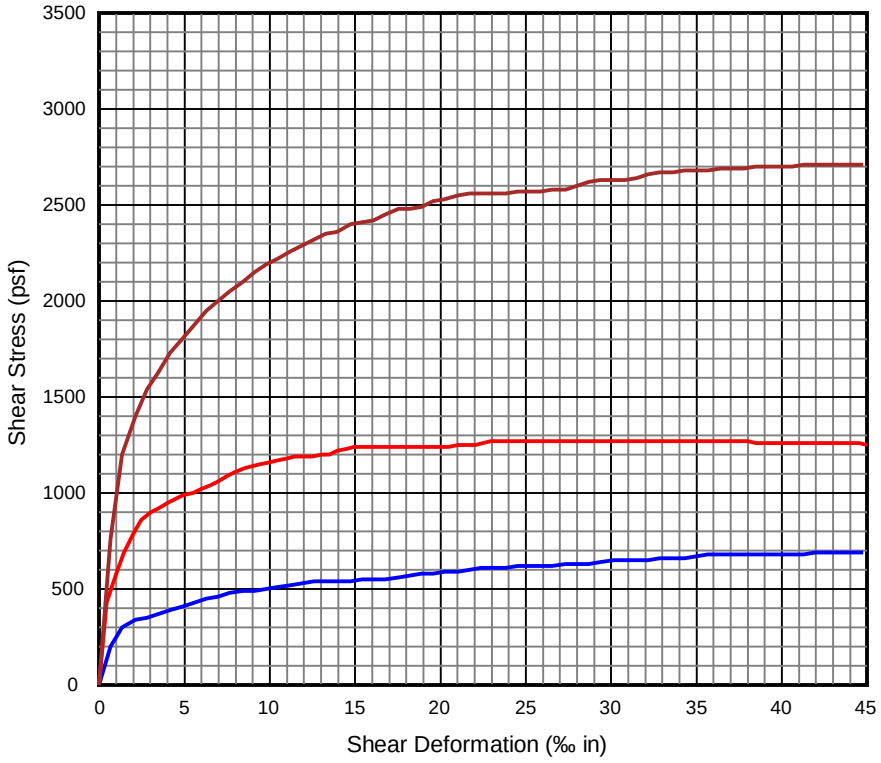
	Boring No.	Depth (ft)	USCS	γ_d (pcf)	w (%)	C_{pk} (psf)	ϕ_{pk} (°)	C_{rs} (psf)	ϕ_{rs} (°)
●	1A+3A	1 - 5	(SM) Silty sand, fine / Remolded (RC=90%)	118.8	7.5	177.4	32.8	133.5	32.6

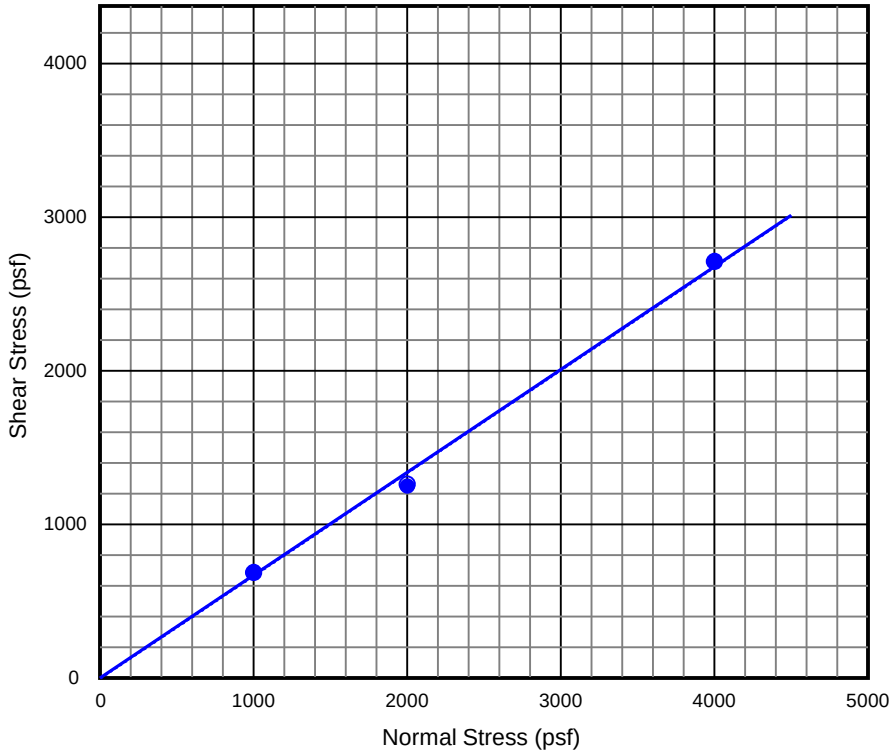
Terracon

DIRECT SHEAR TESTS (ASTM D3080)

Project:	Tentative Tract No. 37305				
Location:	Nichols Road and Interstate 15, Lake Elsinore, California				
Job Number:	CB175281	Engineer:		Exhibit:	C-4

J:\2017\CB175281\Working Files\Laboratory-Field Data-Boring Logs\LabSuite_CB175281.csv





	Boring No.	Depth (ft)	USCS	γ_d (pcf)	w (%)	C_{pk} (psf)	ϕ_{pk} (°)	C_{rs} (psf)	ϕ_{rs} (°)
●	3	1	(ML) Sandy silt / Undisturbed	105.3	3.5	0.0	33.8	0.0	33.8

Terracon

DIRECT SHEAR TESTS (ASTM D3080)

Project:	Tentative Tract No. 37305				
Location:	Nichols Road and Interstate 15, Lake Elsinore, California				
Job Number:	CB175281	Engineer:		Exhibit:	C-5

J:\2017\CB175281\Working Files\Laboratory-Field Data-Boring Logs\LabSuite_CB175281.csv

Table 1 - Laboratory Tests on Soil Samples

CHJ Consultants
Nichols RD & I-215
Your #CB175281, HDR Lab #18-0012LAB
10-Jan-18

Sample ID			1A+3A
Resistivity		**Units**	
as-received		ohm-cm	232,000
saturated		ohm-cm	6,400
pH			6.9
Electrical Conductivity		mS/cm	0.02
Chemical Analyses			
Cations			
calcium	Ca^{2+}	mg/kg	13
magnesium	Mg^{2+}	mg/kg	6.8
sodium	Na^{1+}	mg/kg	10
potassium	K^{1+}	mg/kg	11
Anions			
carbonate	CO_3^{2-}	mg/kg	ND
bicarbonate	HCO_3^{1-}	mg/kg	46
fluoride	F^{1-}	mg/kg	ND
chloride	Cl^{1-}	mg/kg	5.4
sulfate	SO_4^{2-}	mg/kg	4.4
phosphate	PO_4^{3-}	mg/kg	5.2
Other Tests			
ammonium	NH_4^{1+}	mg/kg	ND
nitrate	NO_3^{1-}	mg/kg	8.4
sulfide	S^{2-}	qual	na
Redox		mV	na

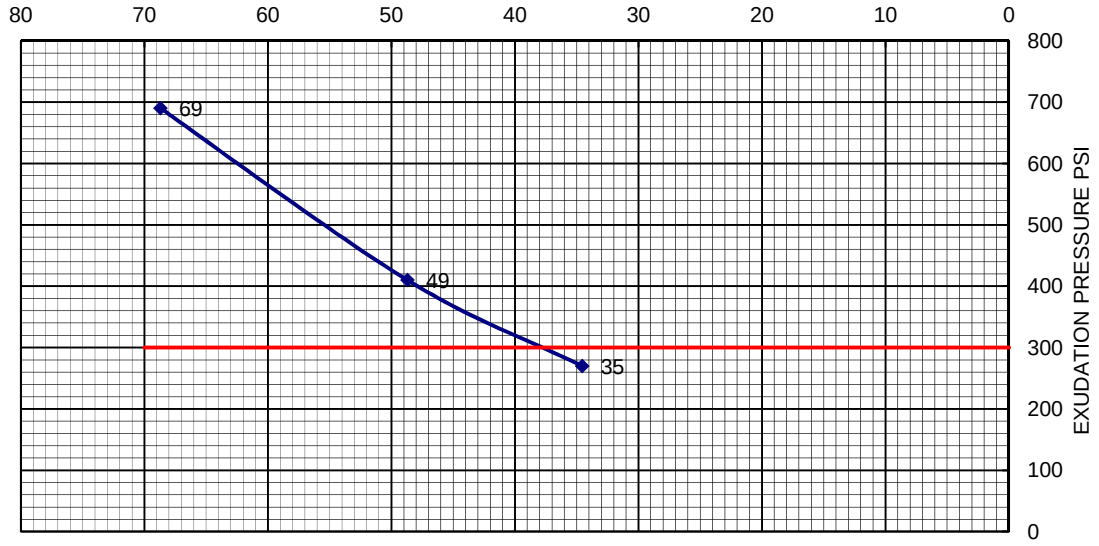
Resistivity per ASTM G187, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B.
Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction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

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

Traffic Index (T.I.) 5.0	A	B	C	D
COMPACTOR AIR PRESSURE P.S.I.	200	250	350	
INITIAL MOISTURE %	4.9	4.9	4.9	
WATER ADDED, ML	60	50	40	
WATER ADDED %	5.4	4.6	3.6	
MOISTURE AT COMPACTION %	10.3	9.5	8.5	
HEIGHT OF BRIQUETTE	2.50	2.45	2.52	
WET WEIGHT OF BRIQUETTE	1173	1147	1171	
DENSITY LB. PER CU.FT.	128.9	129.6	129.8	
STABILOMETER PH AT 1000 LBS.	48	35	20	
2000 LBS.	92	71	43	
DISPLACEMENT	3.50	3.30	3.10	
R-VALUE	35	49	69	
EXUDATION PRESSURE	270	410	690	
THICK. INDICATED BY STAB.	1.05	0.82	0.50	
EXPANSION PRESSURE	0	5	24	
THICK. INDICATED BY E.P.	0.00	0.17	0.80	

EXUDATION CHART

R-VALUE



R-Value: 37

Sample No.	Depth (ft)	Soil/Sample Type	SE	w_0 (%)
9A+10A+11A	0 - 5	(SM) Silty sand	18	4.9

Terracon

R-VALUE TEST

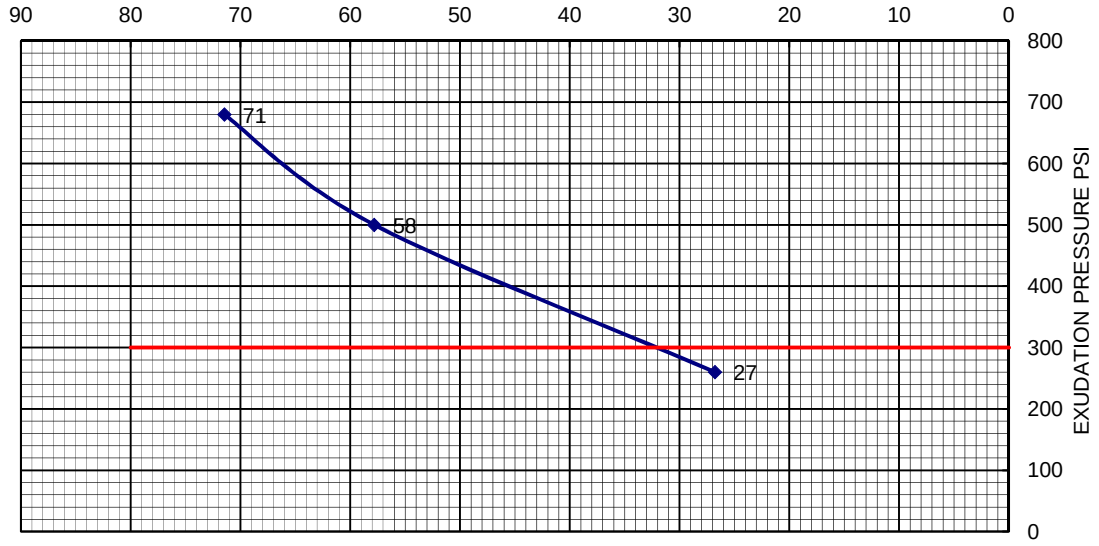
Project:	Tentative Tract No. 37305		
Location:	Nichols Road and Interstate 15, Lake Elsinore, California		
Job No.:	CB175281	Exhibit:	C-7

Prepared at 1/25/2018

Traffic Index (T.I.) 5.0	A	B	C	D
COMPACTOR AIR PRESSURE P.S.I.	75	200	350	
INITIAL MOISTURE %	5.1	5.1	5.1	
WATER ADDED, ML	55	45	35	
WATER ADDED %	5.1	4.1	3.2	
MOISTURE AT COMPACTION %	10.2	9.2	8.3	
HEIGHT OF BRIQUETTE	2.45	2.47	2.49	
WET WEIGHT OF BRIQUETTE	1129	1149	1147	
DENSITY LB. PER CU.FT.	126.7	129.1	128.9	
STABILOMETER PH AT 1000 LBS.	44	27	20	
2000 LBS.	100	51	34	
DISPLACEMENT	4.10	3.90	3.70	
R-VALUE	27	58	71	
EXUDATION PRESSURE	260	500	680	
THICK. INDICATED BY STAB.	1.17	0.68	0.46	
EXPANSION PRESSURE	0	6	19	
THICK. INDICATED BY E.P.	0.00	0.20	0.63	

EXUDATION CHART

R-VALUE



R-Value: 32

Sample No.	Depth (ft)	Soil/Sample Type	SE	w_0 (%)
12A	5 - 10	(SM) Silty sand	23	5.1

Terracon

R-VALUE TEST

Project:	Tentative Tract No. 37305		
Location:	Nichols Road and Interstate 15, Lake Elsinore, California		
Job No.:	CB175281	Exhibit:	C-8

Prepared at 1/25/2018

ASPHALT CONCRETE STRUCTURAL SECTION DESIGN

R-Value used	32

Traffic Index (T.I.)	Recommended Street Sections	
5.00	0.25' AC / 0.45' AB Class 2	0.50' AC / Native
5.50	0.25' AC / 0.55' AB Class 2	0.55' AC / Native
6.00	0.30' AC / 0.60' AB Class 2	0.65' AC / Native
6.50	0.30' AC / 0.70' AB Class 2	0.70' AC / Native
7.00	0.35' AC / 0.75' AB Class 2	0.80' AC / Native
7.50	0.40' AC / 0.75' AB Class 2	0.85' AC / Native
8.00	0.40' AC / 0.90' AB Class 2	0.95' AC / Native
8.50	0.45' AC / 0.90' AB Class 2	1.05' AC / Native
9.00	0.45' AC / 1.05' AB Class 2	1.10' AC / Native
9.50	0.50' AC / 1.05' AB Class 2	1.20' AC / Native
10.00	0.55' AC / 1.10' AB Class 2	1.30' AC / Native
10.50	0.55' AC / 1.25' AB Class 2	1.40' AC / Native
11.00	0.60' AC / 1.25' AB Class 2	1.45' AC / Native
11.50	0.60' AC / 1.35' AB Class 2	1.55' AC / Native
12.00	0.65' AC / 1.40' AB Class 2	1.60' AC / Native

NOTE: MIN. A.C. THICKNESS IS 0.25' MIN. A.B. THICKNESS IS 0.35'

All thicknesses arerounded to the nearest 0.05 foot.

The above values may not reflect applicable county or city minimum standards.

A safety factor of 0.20 for the G.E. of the A.C. is included as per Caltrans.

The values also include a safety factor of 0.10 for A.C./ native soil.

Some agencies do not permit placing A.C. over native soil.

PARKING LOT PCC SECTION DESIGN

R-Value	Concrete Compressive Strength, f_c (psi)	Flexural Strength, M_r (psi)
32	*3600*	*600*

Traffic Category	ADTT	PCC Section (in)*
A	1	4.5
A	10	5
B	25	5.5
B	300	6
C	100	6.5
C	300	6.5
C	700	7
D	700	8
Modulus of subgrade reaction, k (pci)		145

* Rough-textured, angular-shaped aggregates

Terracon

AC & PCC STRUCTURAL SECTION DESIGN

Project:	Tentative Tract No. 37305		
Location:	Nichols Road and Interstate 15, Lake Elsinore, California		
Job No.:	CB175281	Exhibit:	C-9

ASPHALT CONCRETE STRUCTURAL SECTION DESIGN

R-Value used	37

Traffic Index (T.I.)	Recommended Street Sections	
5.00	0.25' AC / 0.35' AB Class 2	0.45' AC / Native
5.50	0.25' AC / 0.50' AB Class 2	0.50' AC / Native
6.00	0.30' AC / 0.50' AB Class 2	0.60' AC / Native
6.50	0.30' AC / 0.60' AB Class 2	0.65' AC / Native
7.00	0.35' AC / 0.65' AB Class 2	0.75' AC / Native
7.50	0.40' AC / 0.65' AB Class 2	0.80' AC / Native
8.00	0.40' AC / 0.75' AB Class 2	0.90' AC / Native
8.50	0.45' AC / 0.80' AB Class 2	0.95' AC / Native
9.00	0.45' AC / 0.90' AB Class 2	1.05' AC / Native
9.50	0.50' AC / 0.95' AB Class 2	1.10' AC / Native
10.00	0.55' AC / 0.95' AB Class 2	1.20' AC / Native
10.50	0.55' AC / 1.05' AB Class 2	1.30' AC / Native
11.00	0.60' AC / 1.10' AB Class 2	1.35' AC / Native
11.50	0.60' AC / 1.20' AB Class 2	1.45' AC / Native
12.00	0.65' AC / 1.20' AB Class 2	1.50' AC / Native

NOTE: MIN. A.C. THICKNESS IS 0.25' MIN. A.B. THICKNESS IS 0.35'

All thicknesses arerounded to the nearest 0.05 foot.

The above values may not reflect applicable county or city minimum standards.

A safety factor of 0.20 for the G.E. of the A.C. is included as per Caltrans.

The values also include a safety factor of 0.10 for A.C./ native soil.

Some agencies do not permit placing A.C. over native soil.

PARKING LOT PCC SECTION DESIGN

R-Value	Concrete Compressive Strength, f_c (psi)	Flexural Strength, M_r (psi)
37	*3600*	*600*
Traffic Category	**ADTT**	**PCC Section (in)***
A	1	4.5
A	10	5
B	25	5.5
B	300	6
C	100	6.5
C	300	6.5
C	700	7
D	700	7.5
Modulus of subgrade reaction, k (pci)		160.6

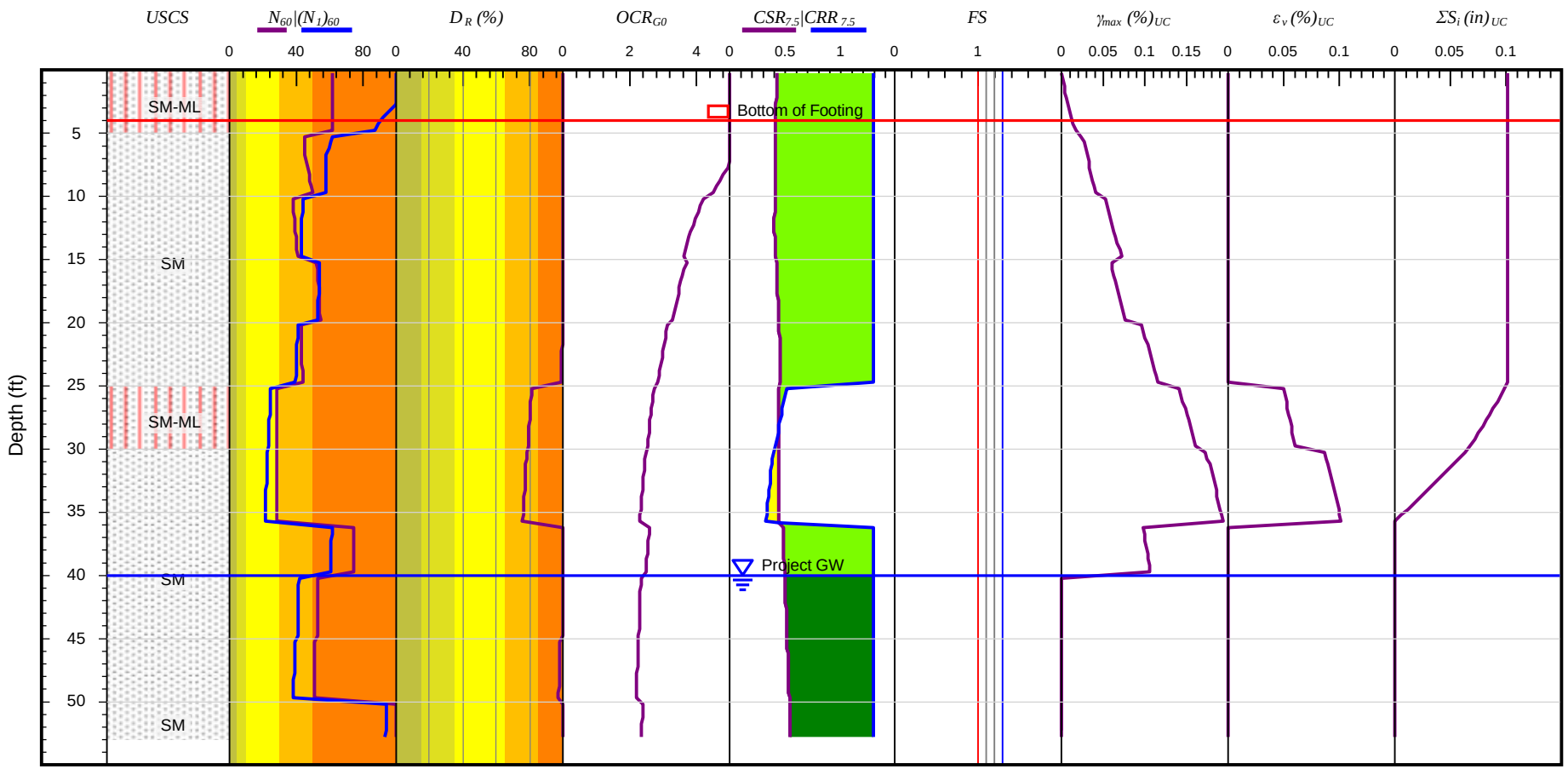
* Rough-textured, angular-shaped aggregates

Terracon

AC & PCC STRUCTURAL SECTION DESIGN

Project:	Tentative Tract No. 37305		
Location:	Nichols Road and Interstate 15, Lake Elsinore, California		
Job No.:	CB175281	Exhibit:	C-10

GEOTECHNICAL CALCULATIONS



SM-ML

SM

Earthquake & Groundwater Information:
Magnitude = 6.77
Max. Acceleration = 0.865 g
Project GW = 40 ft
Maximum Settlement = 0.10 in
Settl. at Bottom of Footing = 0.10 in

Liquefaction: Idriss & Boulanger (2008)
Settl.: [dry] UCLA (2008-14); [sat] Idriss & Boulanger (2008)
Lateral spreading: Idriss & Boulanger (2008)
M correction: [Sand] Boulanger & Idriss(2004)
σv correction: Idriss & Boulanger (2008)
Stress reduction: Idriss & Boulanger (2008)

Terracon

Seismic Settlement Potential - SPT Data

Project:	Tentative Tract No. 37305				
Location:	Nichols Road and Interstate 215, Lake Elsinore, California				
Job Number:	CB175281	Boring No.:	B-2 (2018)	Exhibit:	D-1

J:\2017\CB175281\Working Files\Calculations-Analyses\GeoSuite_CB175281_B-2.csv

Prepared at 2/2/2018 3:03:41 PM

PREVIOUS EXPLORATION RESULTS

Previous Exploratory Borings

APPENDIX "B"

EXPLORATORY LOGS

KEY TO LOGS

LEGEND OF LAB/FIELD TESTS:

Blows	A measure of the penetration resistance of soil expressed as the number of hammer blows required to advance the indicated sampler 6 inches (or less if noted). Samplers are driven with an automatic hammer that drops a 140-pound weight 30 inches for each blow. After the required seating, samplers are advanced up to 18 inches ahead of the boring, providing up to three sets of blows per drive.
Bulk	Indicates Bulk Sample
Consol.	Consolidation Test (ASTM D2435/4546)
Cor.	Chemical/Corrosivity Tests (ASTM G187, D4327, D4972)
Dist.	Indicates Disturbed Sample
DS	Direct Shear Test (ASTM D3080)
MDC	Maximum Density Optimum Moisture Test (ASTM D1557)
N.R.	Indicates No Recovery of Sample
Pass #200	Wash through #200 Screen (ASTM D422)
Ring	Indicates Relatively Undisturbed Ring Sample. The number of blows per 6 inches required to drive a California sampler (3-1/4" O.D. and 2-3/8" I.D.) 18 inches using a 140-pound weight falling 30 inches was recorded.
SA	Sieve Analysis (ASTM D422)
SPT	Indicates Sample Obtained with an Unlined Standard Penetration Test Sampler (2" O.D. and 1-3/8" I.D.)

UNIFIED SOIL CLASSIFICATION SYSTEM

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size)			
GRAVELS More than 50% of coarse fraction larger than No.4 sieve size	Clean Gravels (Less than 5% 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 (More than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No.4 sieve size	Clean Sands (Less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more 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 of 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 50% or greater		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

LABORATORY CLASSIFICATION CRITERIA

GW $C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}^2}{D_{10} \times D_{60}}$ between 1 and 3

GP Not meeting all gradation requirements for GW

GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
GC	Atterberg limits above "A" line with P.I. greater than 7	

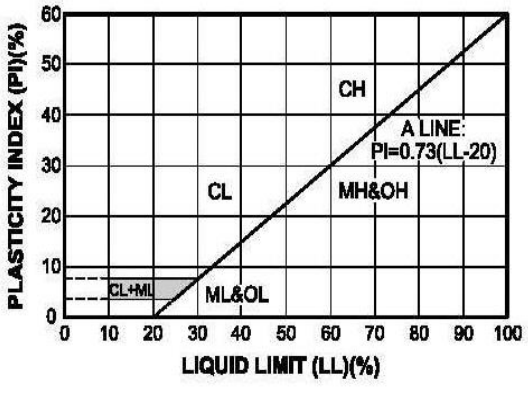
SW $C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{D_{30}^2}{D_{10} \times D_{60}}$ between 1 and 3

SP Not meeting all gradation requirements for SW

SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size).
Coarse-grained soils are classified as follows:
Less than 5 percent.....GW, GP, SW, SP
More than 12 percent.....GM, GC, SM, SC
5 to 12 percent.....Borderline cases requiring dual symbols

PLASTICITY CHART



EXPLORATORY BORING NO. 1

Date Drilled: 4/15/16

Client: Nichols Road Partners

Equipment: CME75 Track Rig

Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1298

Logged by: GA

Measured Depth to Water(ft): N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
		(SM) Silty Sand, fine to coarse, with gravel to 3", brown	Native	X		22 32 40	8.1	103	Ring
					▨		6.3		
5		(SM) Silty Sand, fine to coarse, with clay and gravel to 2", yellowish brown		X		50	9.2	116	Ring
					▨		9.5		
10		Metamorphic bedrock, dark gray, weathered	Bedrock	X		50/5"	7.8	109	Ring
					▨		5.0		
15				X		50/2"	5.3	Dist.	Ring
20				X		50/4"	6.5	104	Ring
			Harder Drilling						
25		END OF BORING		X		50/3"	4.1	109	Ring
		REFUSAL ON BEDROCK AT 25' NO GROUNDWATER NO CAVING, NO FILL							
30									

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-1

EXPLORATORY BORING NO. 2

Date Drilled: 4/15/16 | Client: Nichols Road Partners

Equipment: CME75 Track Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1355 | Logged by: GA | Measured Depth to Water(ft): N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
0		(SM) Silty Sand, fine to coarse, with gravel to 1", yellowish brown	Native						
			Debris on surface	X		6 7 9	3.1	106	Ring
5				X		8 10 11	3.2	106	Ring
					X		2.5		
			Auger Chatter						
10				X		17 35 40	4.0	115	Ring
		Metamorphic bedrock recovered as (GM) Sandy Gravel, fine, with silt, gravel to 2", yellowish brown, weathered	Bedrock		X		3.4		
			Hard Drilling						
15				X		50/5"	8.1	105	Ring
20				X		50	11.3	112	Ring
25						50/1"	3.9	107	Ring
			Smoky Auger		X		4.0		
30		END OF BORING				50/1"	N.R.	N.R.	Ring
		REFUSAL ON BEDROCK AT 30' NO GROUNDWATER NO CAVING, NO FILL							

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-2

EXPLORATORY BORING NO. 3

Date Drilled: 4/18/16 | Client: Nichols Road Partners

Equipment: CME75 Truck Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1315 | Logged by: GA | Measured Depth to Water(ft): N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
		(SM) Silty Sand, fine to coarse, with gravel to 2", dark yellowish brown	Fill	X		11 37 50/5"	4.1	114	Ring
					▨		4.4		
		(SM) Silty Sand, fine to coarse, with gravel to 2", dark yellowish brown	Native						
5				X		26 36 43	3.7	117	Consol., Ring
10				X		16 24 26	4.4	116	Pass #200, Ring
					▨		3.5		Cor., DS, MDC, SA
15		(SM) Silty Sand, fine to coarse, with gravel to 1/4", light yellowish brown		X		19 33 40	3.4	121	Pass #200, Ring
20				X		30 37 38	3.2	118	Pass #200, Ring
25		(SP-SM) Sand, fine to coarse, with silt and gravel to 1/4", yellowish brown		X		23 28 32	2.2	114	Pass #200, Ring
30		(ML) Sandy Silt, fine to coarse, with gravel to 1/2", yellowish brown	Hard Drilling	X		20 17 20	4.1	118	Pass #200, Ring

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-3a

EXPLORATORY BORING NO. 3

Date Drilled: 4/18/16 | Client: Nichols Road Partners

Equipment: CME75 Truck Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1315 | Logged by: GA | Measured Depth to Water(ft): N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
		(SM) Silty Sand, fine to coarse, with gravel to 1/2", yellowish brown		X		17 23 24	7.2	115	Pass #200, Ring
40				X		16 20 22	10.5	118	Pass #200, Ring
			Added Water						
45		(SM) Silty Sand, fine to coarse, with clay and gravel to 1/4", yellowish brown		X		14 32 50/5"	8.4	120	Pass #200, Ring
			Very Hard Drilling						
50				X		20 31 34	11.4	122	Pass #200, Ring
		END OF BORING NO REFUSAL, NO BEDROCK NO GROUNDWATER NO CAVING, FILL TO 4'							
55									
60									
65									

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-3b

EXPLORATORY BORING NO. 4

Date Drilled: 4/18/16 | Client: Nichols Road Partners

Equipment: CME75 Truck Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1325 | Logged by: GA | Measured Depth to Water(ft): N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
		(ML) Sandy Silt, fine to coarse, with gravel to 1", dark yellowish brown	Fill	X		32 50/5"	20.0	104	Ring
		(SM) Silty Sand, fine to coarse, with clay and gravel to 2", yellowish brown	Native		▨		5.0		
5				X		23 35 42	5.4	124	Ring
10				X		17 13 16	6.1	119	Consol., Ring
					▨		6.9		Cor., DS, MDC, SA
15				X		14 16 22	7.5	125	Ring
20				X		12 23 24	4.4	116	Ring
25			Hard Drilling	X		16 17 17	8.0	126	Ring
30		(SM) Silty Sand, fine to coarse, with gravel to 1", yellowish brown	Added Water	X		10 12 15	6.2	123	Ring

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-4a

EXPLORATORY BORING NO. 4

Date Drilled: 4/18/16 | Client: Nichols Road Partners

Equipment: CME75 Truck Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1325 | Logged by: GA | Measured Depth to Water(ft): N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
		(SM) Silty Sand, fine to coarse, with gravel to 1", yellowish brown	Added Water	X		14 18 16	6.5	112	Ring
40			Added Water	X		10 16 20	8.6	124	Ring
45			Added Water	X		15 25 31	7.8	124	Ring
50		(ML) Sandy Silt, fine, with clay, brown		X		18 24 44	10.8	124	Ring
		END OF BORING NO REFUSAL, NO BEDROCK NO GROUNDWATER NO CAVING, FILL TO 3'							
55									
60									
65									

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-4b

EXPLORATORY BORING NO. 5

Date Drilled: 4/15/16 | Client: Nichols Road Partners

Equipment: CME75 Track Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1356 | Logged by: GA | Measured Depth to Water(ft): N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
		(SM) Silty Sand, fine to coarse, with gravel to 1", light yellowish brown	Fill	X		7 7 9	2.8	102	Ring
					▨		2.8		
5				X		8 7 7	4.1	105	Ring
10				X		23 16 12	4.9	114	Ring
15				X		9 29 31	3.9	Dist.	Ring
					▨		3.7		
20		(SP-SM) Sand, fine to coarse, with silt and gravel to 1", yellowish brown	Native	X		10 18 15	1.7	119	Ring
25		(SM) Silty Sand, fine to coarse, with gravel to 1/2", dark yellowsih brown	Auger Chatter	X		7 9 16	4.1	109	Ring
30				X		24 16 29	3.5	115	Ring

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-5a

EXPLORATORY BORING NO. 5

Date Drilled: 4/15/16

Client: Nichols Road Partners

Equipment: CME75 Track Rig

Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1356

Logged by: GA

Measured Depth to Water(ft): N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
		Metamorphic bedrock, greenish gray, weathered	Bedrock	X		50	8.6	108	Ring
							8.8		
40				X		50	10.6	104	Ring
			Harder Drilling						
45				X		50/4"	7.9	104	Ring
		END OF BORING							
		REFUSAL ON BEDROCK AT 47'							
50		NO GROUNDWATER							
		NO CAVING, FILL TO 20.5'							
55									
60									
65									

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-5b

EXPLORATORY BORING NO. 6

Date Drilled: 4/18/16 | Client: Nichols Road Partners

Equipment: CME75 Truck Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1325 | Logged by: GA | Measured Depth to Water(ft): N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
		(SM) Silty Sand, fine with medium to coarse, with gravel to 2", yellowish brown	Native	X		5 6 7	3.4	104	Consol., Ring
					▨		3.4		Cor., DS, MDC, SA
5		(GP) Sandy Gravel, fine to coarse, with cobbles to 4", yellowish brown	Auger Chatter	X		12 16 14	2.7	116	Consol., Ring
					▨		2.6		
10				X		27 38 35	5.5	125	Consol., Ring
		(SM) Silty Sand, fine to coarse, with clay and gravel to 1", brown	Less Chatter						
15				X		15 28 36	10.8	126	Consol., Ring
20				X		15 22 30	6.8	126	Consol., Ring
25				X		22 24 30	7.6	121	Consol., Ring
30		(SC) Clayey Sand, fine to coarse, with silt and gravel to 1", brown	Added Water	X		14 22 29	11.3	122	Consol., Ring

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

EXPLORATORY BORING NO. 6

Date Drilled: 4/18/16

Client: Nichols Road Partners

Equipment: CME75 Truck Rig

Driving Weight / Drop / Sampler Size: 140lbs./30in./3.25" O.D.

Surface Elevation(ft): 1325

Logged by: GA

Measured Depth to Water(ft): N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES DRIVE	SAMPLES BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
		(SM) Silty Sand, fine to coarse, with gravel to 1/2", brown		X		13 24 34	10.1	120	Ring
		Metamorphic Bedrock, gray, weathered	Bedrock						
							2.2		
40						50/2"	N.R.	N.R.	Ring
		END OF BORING							
		REFUSAL ON BEDROCK AT 40.5' NO GROUNDWATER NO CAVING, NO FILL							
45									
50									
55									
60									
65									

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-6b

EXPLORATORY BORING NO. 7

Date Drilled: 4/18/16 | Client: Nichols Road Partners

Equipment: CME75 Truck Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./2.0" O.D.

Surface Elevation(ft): 1333 | Logged by: GA | Measured Depth to Water(ft): N/A

DEPTH (ft)	VISUAL CLASSIFICATION	REMARKS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
	(SM) Silty Sand, fine to coarse, with gravel to 3", yellowish brown	Native	X		3 6 7			SPT
				▨		2.7		Cor., DS, MDC, SA
5	(ML) Sandy Silt, fine to coarse, with gravel to 1/2", yellowish brown		X		4 4 5			Pass #200, SPT
10	(SP-SM) Sand, fine to coarse, with silt and gravel to 2", light brown	Gravel lenses	X		10 24 12			Pass #200, SPT
				▨		3.2		
15	(SM) Silty Sand, fine to coarse, with clay and gravel to 1/2", brown	Less Gravel	X		11 15 18			SPT
20			X		10 19 30			SPT
25			X		29 50/5"			SPT
	Metamorphic Bedrock, gray, weathered							
	END OF BORING							
30	REFUSAL ON BEDROCK AT 25.5' NO GROUNDWATER NO CAVING, NO FILL							

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-7

EXPLORATORY BORING NO. 8

Date Drilled: 4/15/16 | Client: Nichols Road Partners

Equipment: CME75 Track Rig | Driving Weight / Drop / Sampler Size: 140lbs./30in./2.0" O.D.

Surface Elevation(ft): 1310 | Logged by: GA | Measured Depth to Water(ft): N/A

DEPTH (ft)	GRAPHIC LOG	VISUAL CLASSIFICATION	REMARKS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
		(SM) Silty Sand, fine with medium to coarse, with gravel to 2", light yellowish brown	Native	X		26 35 46			Pass #200, SPT
					▨		4.5		Cor., DS, MDC, SA
5		(SM) Silty Sand, fine to coarse, with gravel to 1/2", yellowish brown		X		16 18 18			Pass #200, SPT
10				X		11 14 15			Pass #200, SPT
15				X		11 15 20			Pass #200, SPT
		(SM) Silty Sand, fine with medium to coarse, with gravel to 1", yellowish brown			▨		3.4		
20				X		18 20 21			Pass #200, SPT
25				X		9 7 8			Pass #200, SPT
30		(SM) Silty Sand, fine to coarse, with gravel to 1/2", yellowish brown		X		16 28 30			Pass #200, SPT

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

Job No. 16164-3

Enclosure B-8a

EXPLORATORY BORING NO. 8

Date Drilled: 4/15/16

Client: Nichols Road Partners

Equipment: CME75 Track Rig

Driving Weight / Drop / Sampler Size: 140lbs./30in./2.0" O.D.

Surface Elevation(ft): 1310

Logged by: GA

Measured Depth to Water(ft): N/A

DEPTH (ft)	VISUAL CLASSIFICATION	REMARKS	SAMPLES: DRIVE	SAMPLES: BULK	BLOWS/6 IN.	FIELD MOISTURE (%)	DRY UNIT WT. (pcf)	LAB/FIELD TESTS
	(SP-SM) Sand, fine to coarse, with silt,	Interbedded Sand and Silt Hard Drilling	X		14 12 17	11.6		Pass #200, SPT
	(ML) Sandy Silt, fine to coarse, with clay, brown							
40			X		19 22 14			Pass #200, SPT
45			X		9 11 23			Pass #200, SPT
50	Metamorphic Bedrock, gray, weathered		X		50	3.0		SPT
	END OF BORING							
	BEDROCK AT 50' NO GROUNDWATER NO CAVING, NO FILL							
55								
60								
65								

10331-3 16164-3.GPJ CHJ.GDT 5/4/16

CHJ

SOUTH NICHOLS GRADING PROJECT
SOUTH OF NICHOLS ROAD, EAST OF I-15, LAKE ELSINORE, CA

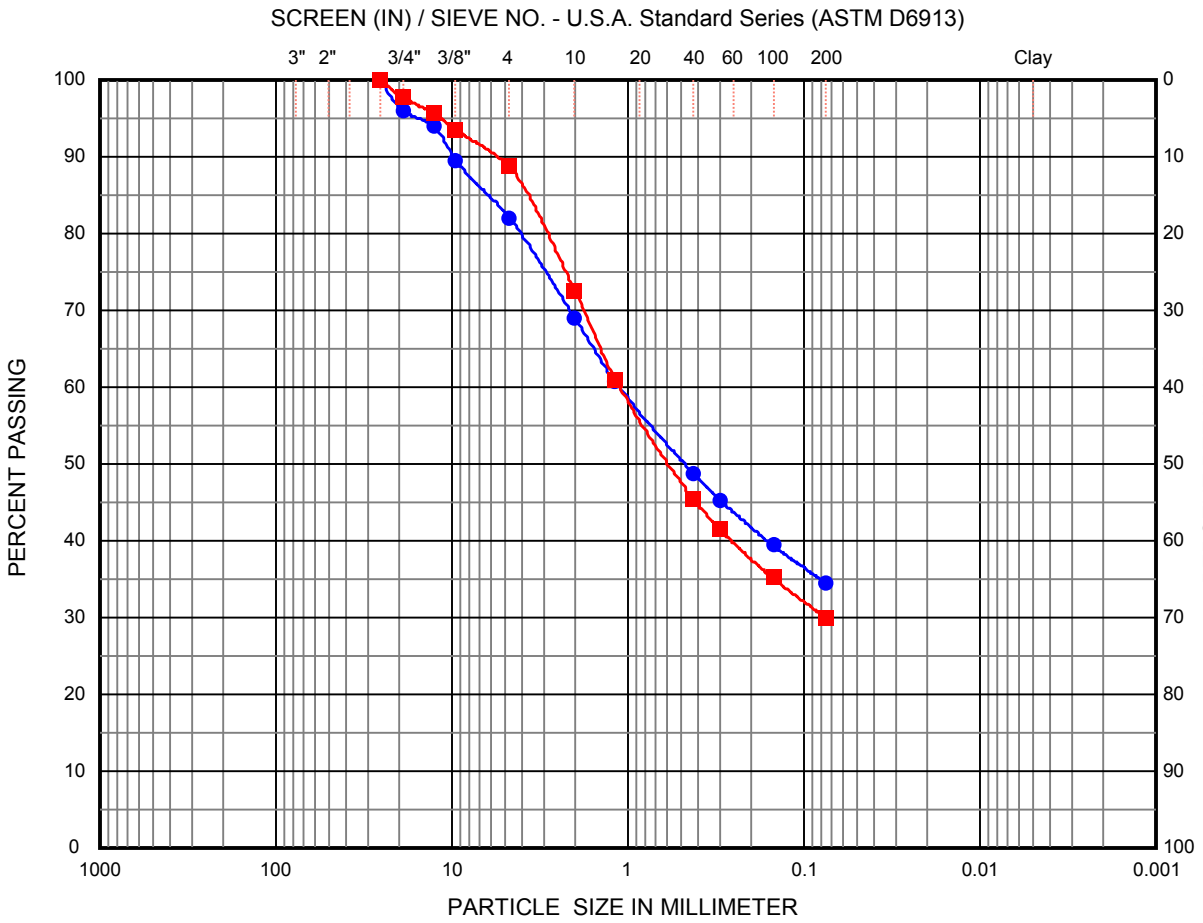
Job No. 16164-3

Enclosure B-8b

Previous Laboratory Test Results

APPENDIX "C"

LABORATORY TESTING



Cobbles & Boulders	Gravel		Sand			Silt	Clay
	Coarse	Fine	Coarse	Medium	Fine		

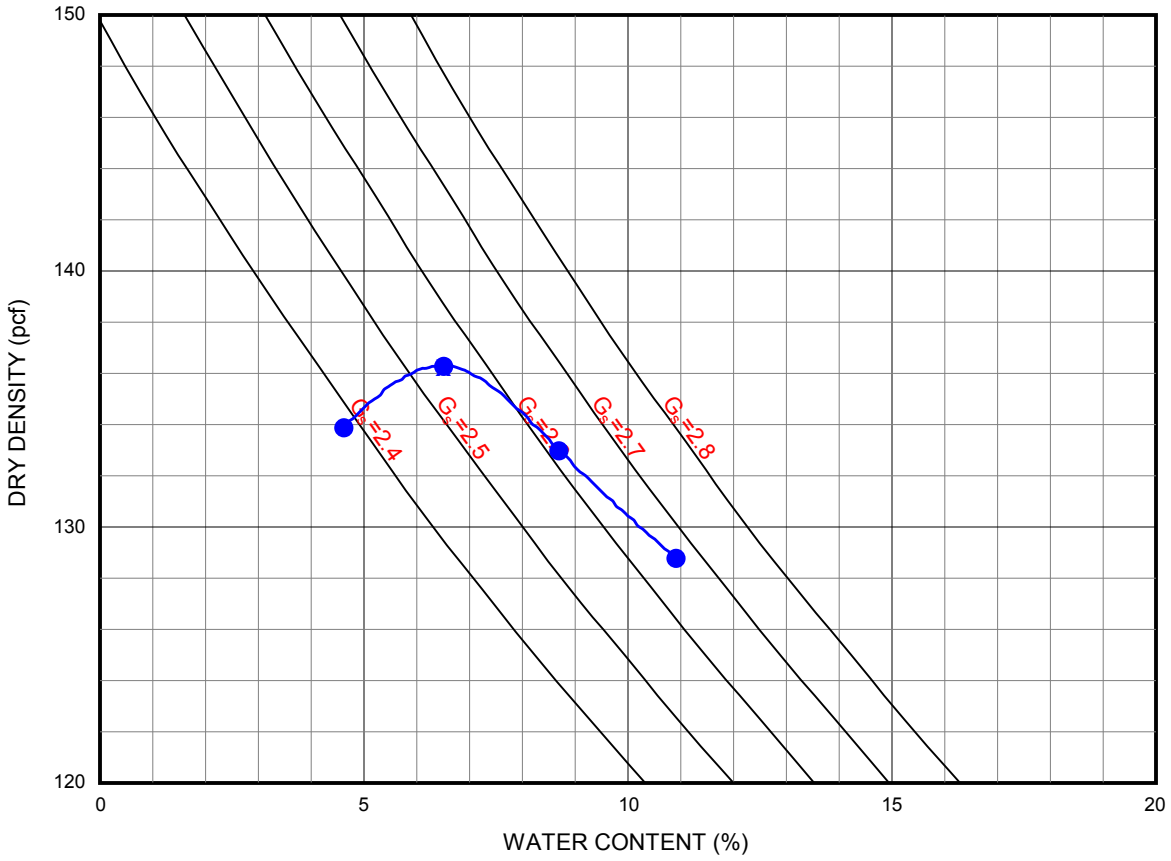
	Sample No.	Gravel	Sand	Fines	Clay	D_{10}	D_{30}	D_{50}	D_{60}	C_u	C_c
●	1A+2A (3 - 7 ft)	17.9	47.5	34.6			0.039	0.476	1.119		
	(SM) Silty sand with gravel										
■	3B+4B+6A+7A+8A (2 - 12 ft)	11.3	58.7	30.0			0.075	0.593	1.116		
	(SM) Silty sand, fine to coarse with gravel										

PARTICLE SIZE DISTRIBUTION (ASTM D6913)

Project:	Proposed South Nichols Grading Project				
Location:	South of Nichols Road, East of Interstate 15, Lake Elsinore, California				
Job Number:	16164-3	Engineer:	fy	Enclosure:	C-1

G:\2016\16164-3 Nichols Rd Partners - S Nichols Grading - Lk Elsinore\lab\LabSuite_16164-3.csv

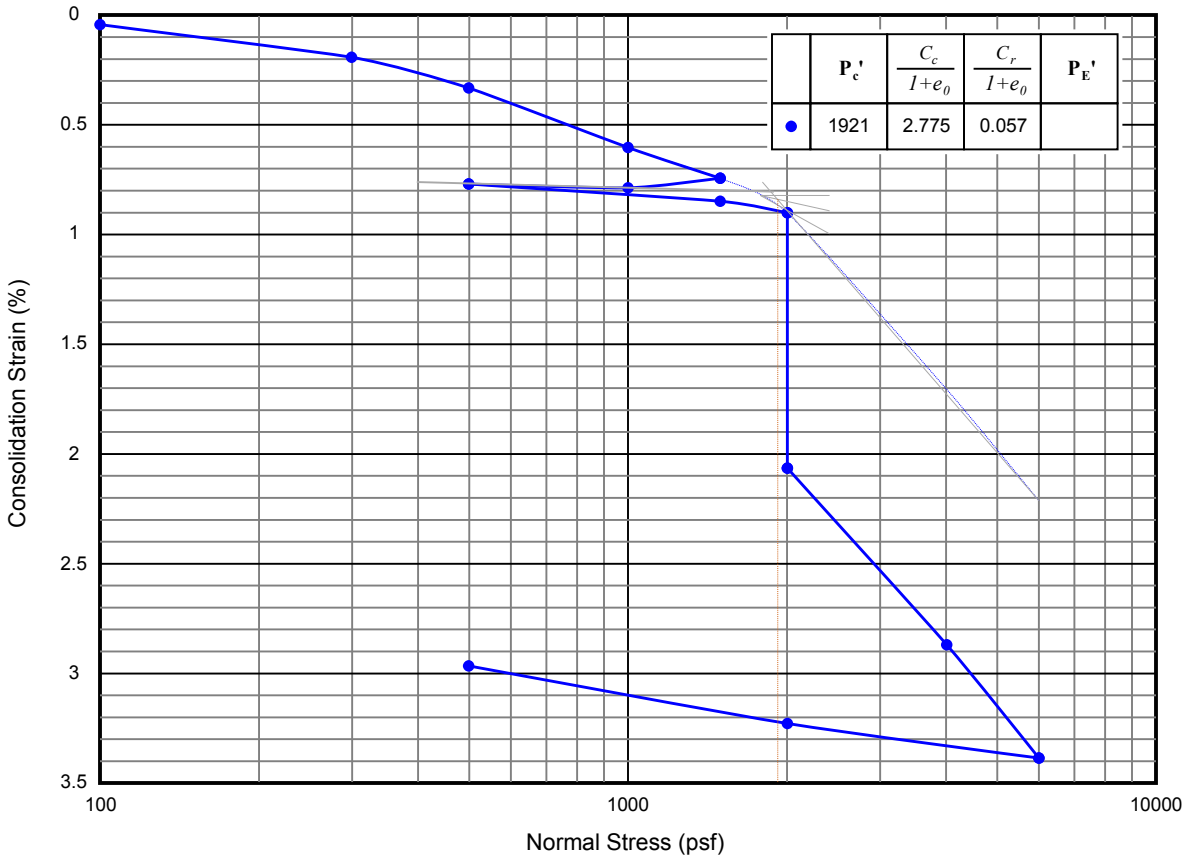
Prepared at 5/2/2016 10:34:47 AM



	Sample No.	USCS Classification	γ_{dmax} (pcf)	w_o (%)
●	3B+4B+6A+7A+8A (2 - 12 ft)	(SM) Silty sand, fine to coarse with gravel	136.0	6.5

COMPACTION CURVES (ASTM D1557)

Project:	Proposed South Nichols Grading Project				
Location:	South of Nichols Road, East of Interstate 15, Lake Elsinore, California				
Job Number:	16164-3	Engineer:	fy	Enclosure:	C-2



	Boring No.	Depth (ft)	USCS Classification	γ_d (pcf)	w (%)	HCS (%)
●	3	5	(SM) Silty sand, fine to coarse	110.9	4.7	1.2

CONSOLIDATION TESTS (ASTM D2435/4546)

Project:	Proposed South Nichols Grading Project				
Location:	South of Nichols Road, East of Interstate 15, Lake Elsinore, California				
Job Number:	16164-3	Engineer:	fy	Enclosure:	C-3

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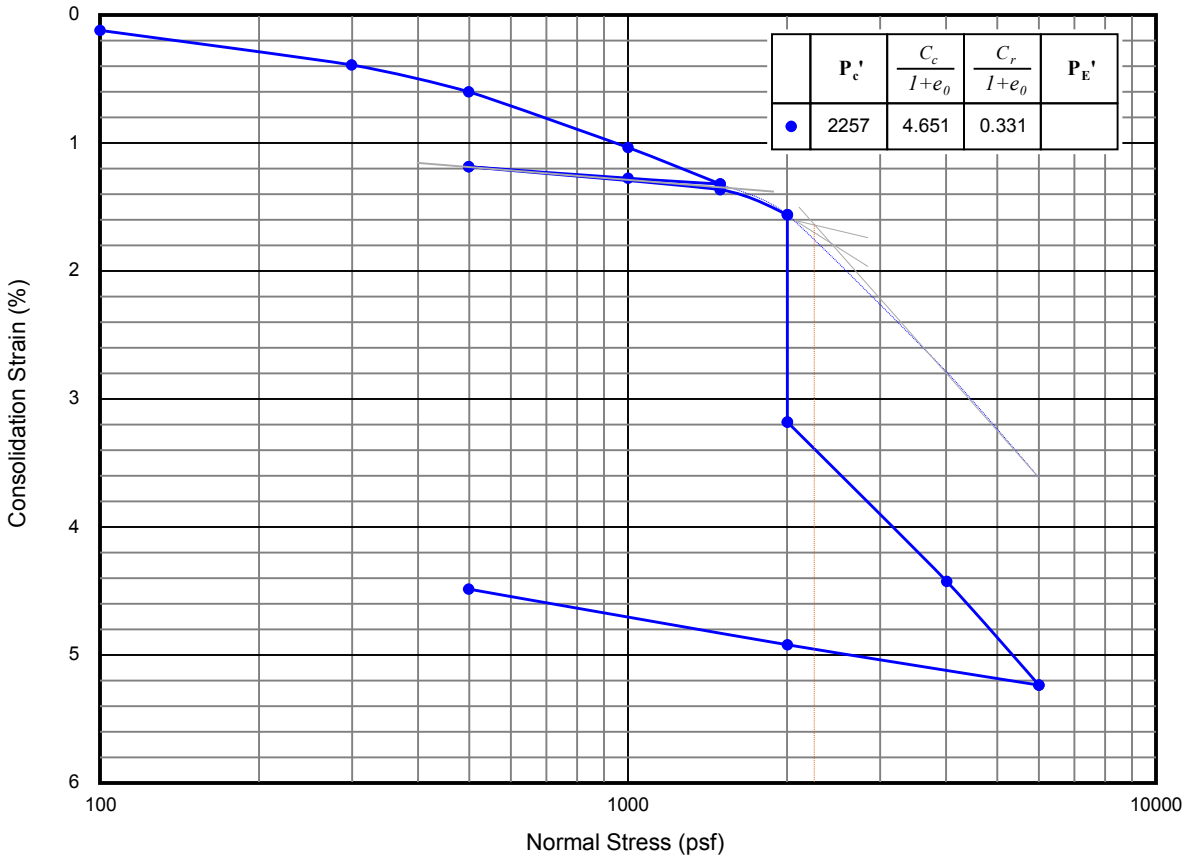

	Boring No.	Depth (ft)	USCS Classification	γ_d (pcf)	w (%)	HCS (%)
●	4	10	(SM) Silty sand, fine to coarse	113.5	6.3	1.6

CONSOLIDATION TESTS (ASTM D2435/4546)

Project:	Proposed South Nichols Grading Project				
Location:	South of Nichols Road, East of Interstate 15, Lake Elsinore, California				
Job Number:	16164-3	Engineer:	fy	Enclosure:	C-4

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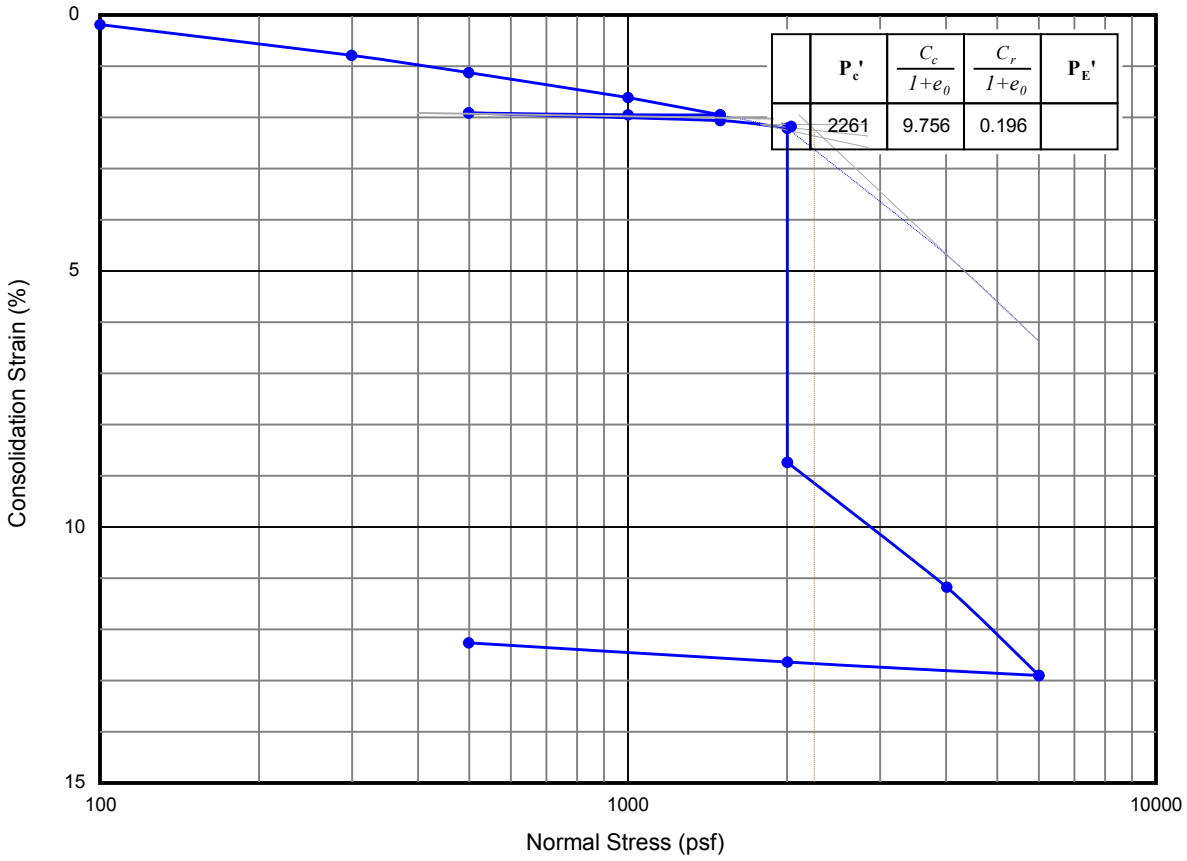
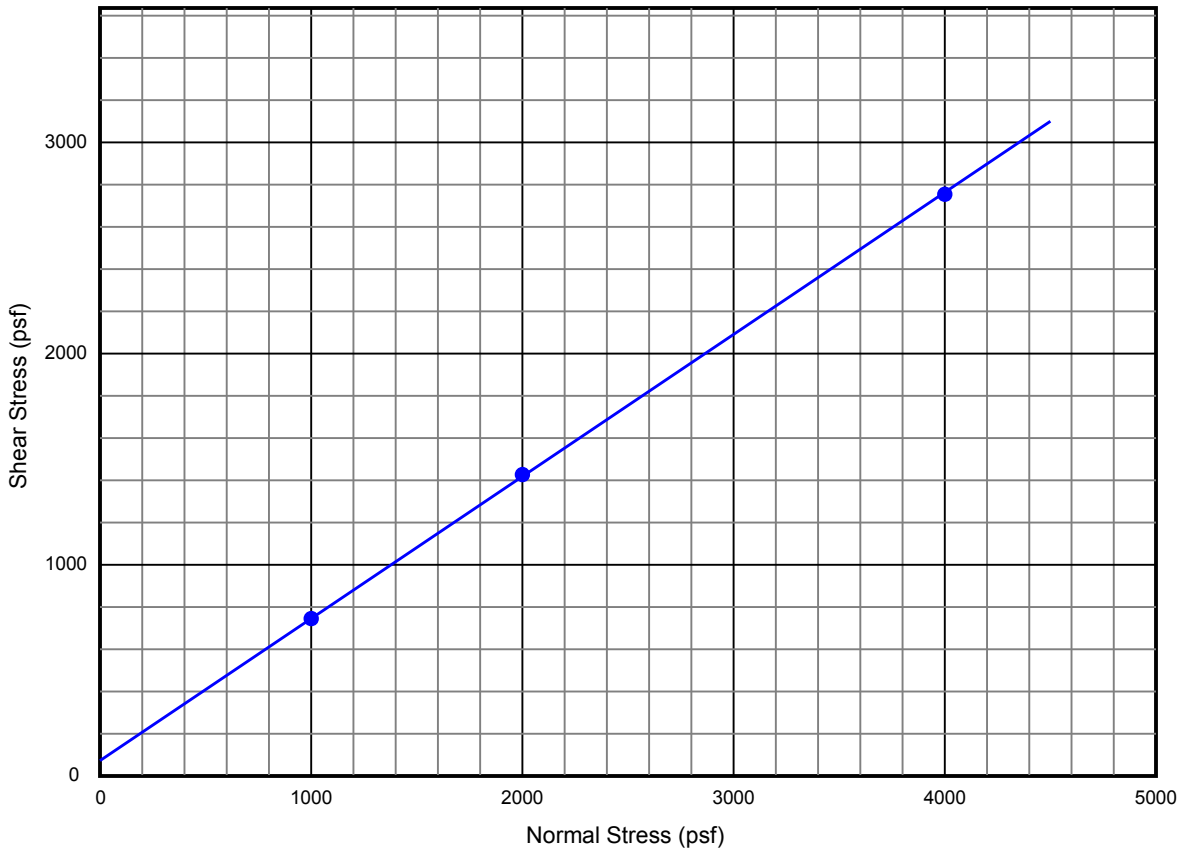


	Boring No.	Depth (ft)	USCS Classification	γ_d (pcf)	w (%)	HCS (%)
●	6	1	(SM) Silty sand, fine with medium to coarse	97.0	4.6	6.5

CONSOLIDATION TESTS (ASTM D2435/4546)

Project:	Proposed South Nichols Grading Project				
Location:	South of Nichols Road, East of Interstate 15, Lake Elsinore, California				
Job Number:	16164-3	Engineer:	fy	Enclosure:	C-5



	Sample No.	γ_d (pcf)	w (%)	C_{pk} (psf)	ϕ_{pk} (°)	C_{rs} (psf)	ϕ_{rs} (°)
●	3B+4B+6A+7A+8A (2 - 12 ft)	123.3	7.5	91.4	33.8	77.2	33.9
	(SM) Silty sand, fine to coarse with gravel / Remolded (RC=90%)						

DIRECT SHEAR TESTS (ASTM D3080)

Project:	Proposed South Nichols Grading Project				
Location:	South of Nichols Road, East of Interstate 15, Lake Elsinore, California				
Job Number:	16164-3	Engineer:	fy	Enclosure:	C-6

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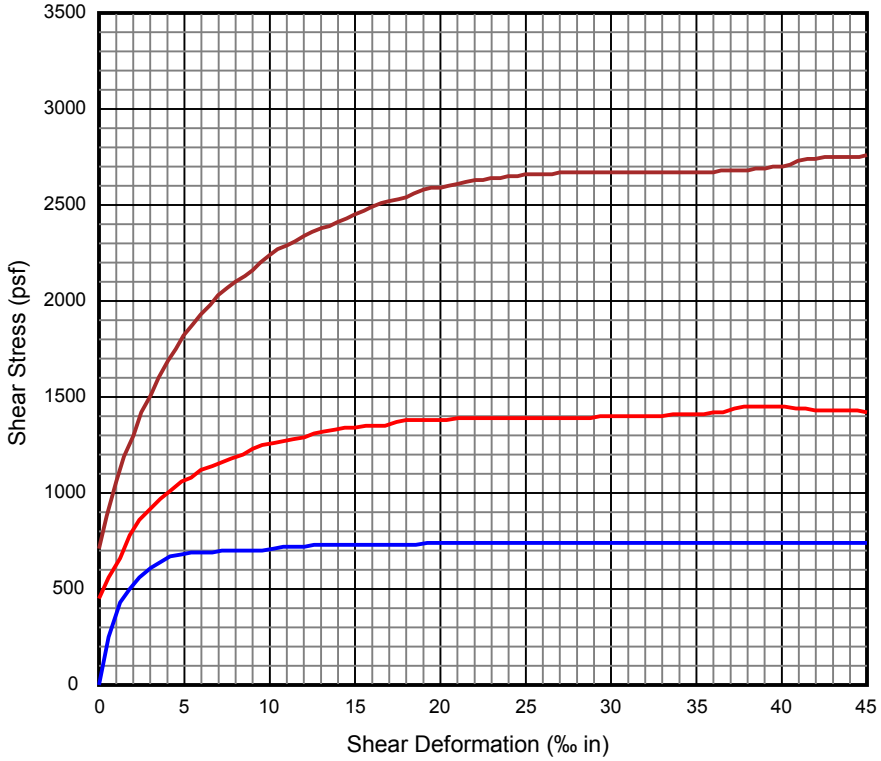

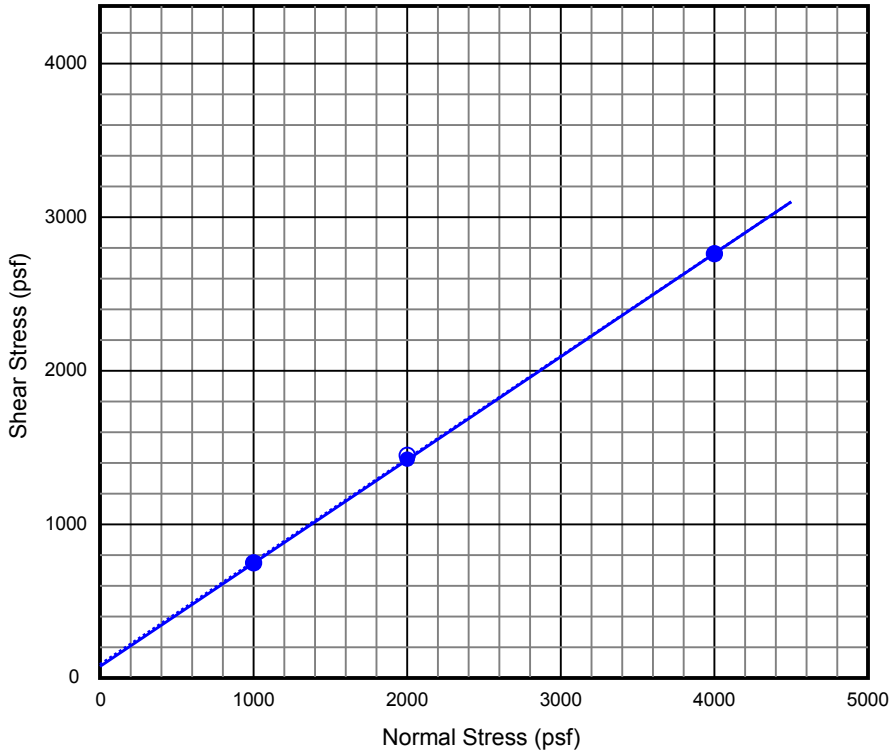

	Sample No.	USCS	γ_d (pcf)	w (%)	C_{pk} (psf)	ϕ_{pk} (°)	C_{rs} (psf)	ϕ_{rs} (°)
●	3B+4B+6A+7A+8A (2 - 12 ft)	(SM) Silty sand, fine to coarse with gravel / Remolded (RC=90%)	123.3	7.5	91.4	33.8	77.2	33.9

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DIRECT SHEAR TESTS (ASTM D3080)

Project:	Proposed South Nichols Grading Project				
Location:	South of Nichols Road, East of Interstate 15, Lake Elsinore, California				
Job Number:	16164-3	Engineer:	fy	Enclosure:	C-7

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FINES CONTENT (ASTM D1140)

Boring No.	3	3	3	3	3	3	6	6
Depth (ft)	10 - 15	15 - 25	25 - 30	30 - 35	35 - 45	45 - 55	5 - 12	12 - 30
Original Dry Mass	195.3	200.3	210.6	200.6	202.2	200.4	217.7	206.4
Dry Mass after Washing	137.9	164.7	190.3	143.4	127.8	119.7	198.2	143.5
Fine Contents (%)	29.4	17.8	9.6	28.5	36.8	40.3	9.0	30.5
Classification	SM	SM	SP-SM	SM	SM	SM	SP-SM	SM
Boring No.	6	7	7	8	8	8	8	8
Depth (ft)	30 - 35	5 - 10	10 - 14	0 - 5	5 - 17	17 - 30	30 - 35	37 - 50
Original Dry Mass	196.9	210.7	227	209.7	196.6	189.8	187.3	176.3
Dry Mass after Washing	110.7	139.2	205.5	127.7	149.9	119.7	125.8	77.8
Fine Contents (%)	43.8	33.9	9.5	39.1	23.8	36.9	32.8	55.9
Classification	SC	SM	SP-SM	SM	SM	SM	SM	ML

CONSOLIDATION TESTS (ASTM D2435/4546)

Boring No.	Depth (ft)	USCS	γ_d (pcf)	w (%)	Pc' (psf)
3	5		110.9	4.7	1921
4	10		113.5	6.3	2257
6	1		97.0	4.6	2261
Boring No.	**$C_c/(1+e_0)$(%)**	**$C_r/(1+e_0)$(%)**	**PE' (psf)**	**HCS (%)**	
3	2.775	0.057		1.2	
4	4.651	0.331		1.6	
6	9.756	0.196		6.5	

DIRECT SHEAR TESTS (ASTM D3080)

Sample No.	Depth (ft)	USCS	γ_d (pcf)	w (%)	C_{pk} (psf)	ϕ_{pk} (°)	C_{rs} (psf)	ϕ_{rs} (°)
3B+4B+6A+7A+8A	2 - 12	SM	123.3	7.5	91.4	33.8	77.2	33.9

COMPACTION CURVES (ASTM D1557)

Sample No.	Depth (ft)	USCS	γ_{dmax} (pcf)	w_o (%)
3B+4B+6A+7A+8A	2 - 12	SM	136.0	6.5

Table 1 - Laboratory Tests on Soil Samples

CHJ Consultants
South Nichols Grading
Your #16164-3, HDR Lab #16-0304LAB
22-Apr-16

Sample ID			3B+4B+6A+ 7A+8A
Resistivity		**Units**	
as-received		ohm-cm	34,400
saturated		ohm-cm	6,400
pH			6.5
Electrical Conductivity		mS/cm	0.03
Chemical Analyses			
Cations			
calcium	Ca^{2+}	mg/kg	12
magnesium	Mg^{2+}	mg/kg	7.2
sodium	Na^{1+}	mg/kg	24
potassium	K^{1+}	mg/kg	4.7
Anions			
carbonate	CO_3^{2-}	mg/kg	ND
bicarbonate	HCO_3^{1-}	mg/kg	79
fluoride	F^{1-}	mg/kg	0.8
chloride	Cl^{1-}	mg/kg	ND
sulfate	SO_4^{2-}	mg/kg	8.8
phosphate	PO_4^{3-}	mg/kg	6.6
Other Tests			
ammonium	NH_4^{1+}	mg/kg	ND
nitrate	NO_3^{1-}	mg/kg	17
sulfide	S^{2-}	qual	na
Redox		mV	na

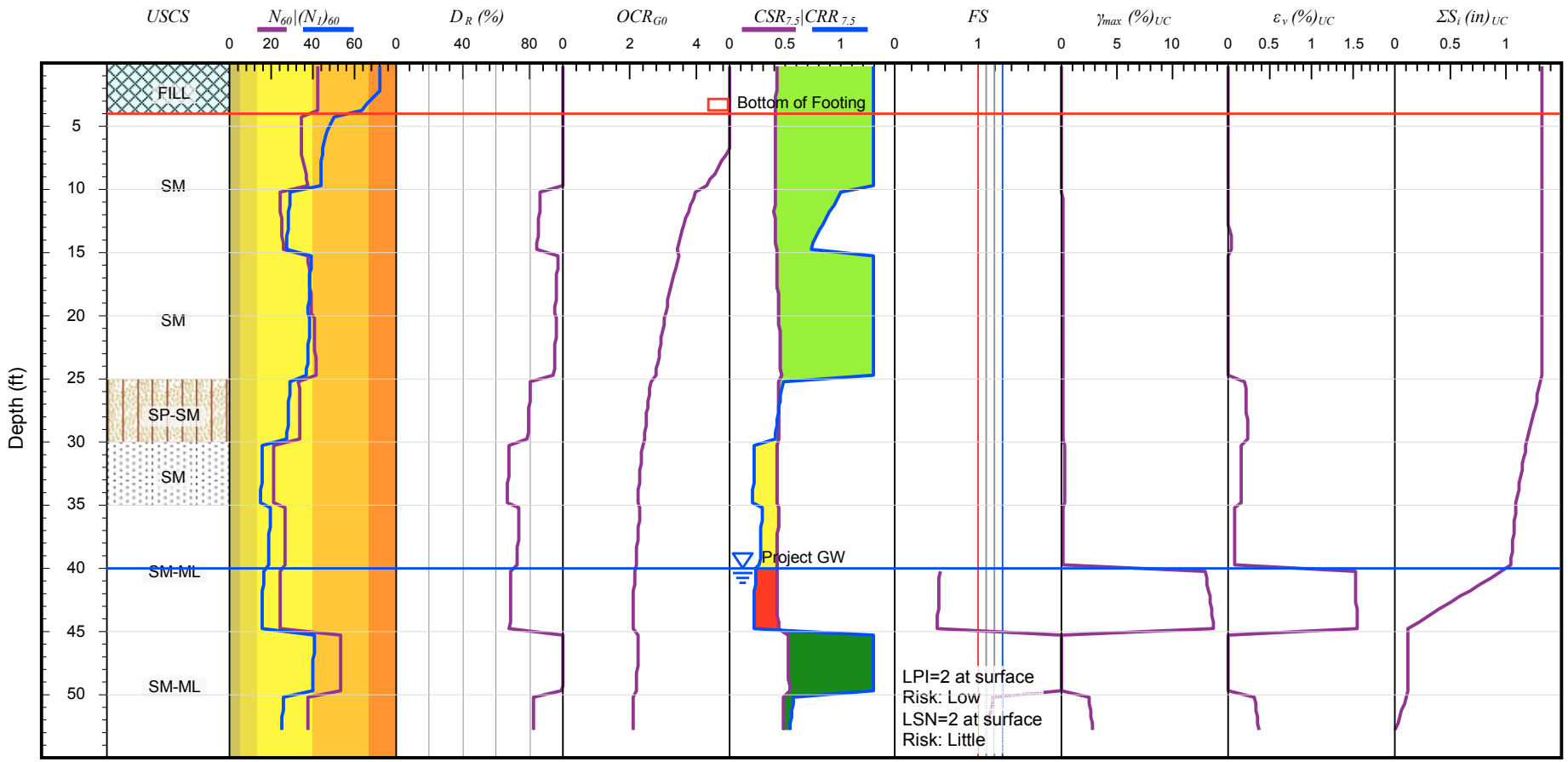
Resistivity per ASTM G187, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B.
Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.
mg/kg = milligrams per kilogram (parts per million) of dry soil.
Redox = oxidation-reduction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

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

Previous Geotechnical Calculations

APPENDIX "D"

GEOTECHNICAL CALCULATIONS



FILL
SP-SM
SM
SM-ML

Earthquake & Groundwater Information:
Magnitude = 6.77
Max. Acceleration = 0.865 g
Project GW = 40 ft
Maximum Settlement = 1.33 in
Settlement at Bottom of Footing = 1.33 in

Liquefaction: Idriss & Boulanger (2008)
Settl.: [dry] UCLA (2008-14); [sat] Idriss & Boulanger (2008)
Lateral spreading: Idriss & Boulanger (2008)
M correction: [Sand] Boulanger & Idriss(2004)
σv correction: Idriss & Boulanger (2008)
Stress reduction: Idriss & Boulanger (2008)

CHJ Consultants

Seismic Settlement Potential - SPT Data

Project:	Proposed South Nichols Grading Project				
Location:	South of Nichols Road, East of Interstate 15, Lake Elsinore, California				
Job Number:	16164-3	Boring No.:	B-3	Enclosure:	D-1

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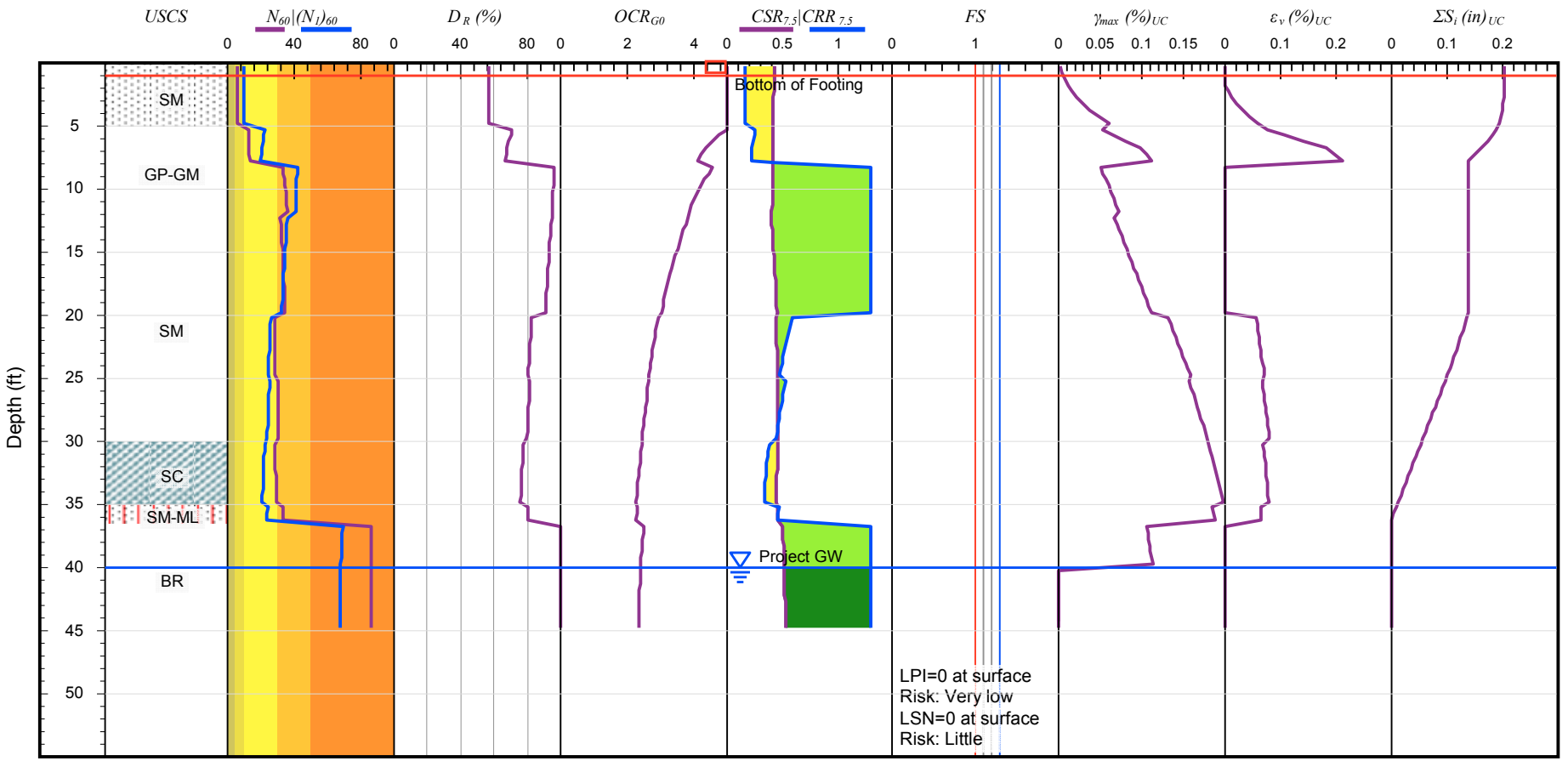

SM SC BR

GP-GM SM-ML

Earthquake & Groundwater Information:
Magnitude = 6.77
Max. Acceleration = 0.865 g
Project GW = 40 ft
Maximum Settlement = 0.20 in
Settlement at Bottom of Footing = 0.20 in

Liquefaction: Idriss & Boulanger (2008)
Settl.: [dry] UCLA (2008-14); [sat] Idriss & Boulanger (2008)
Lateral spreading: Idriss & Boulanger (2008)
M correction: [Sand] Boulanger & Idriss(2004)
σv correction: Idriss & Boulanger (2008)
Stress reduction: Idriss & Boulanger (2008)

CHJ Consultants

Seismic Settlement Potential - SPT Data

Project:	Proposed South Nichols Grading Project				
Location:	South of Nichols Road, East of Interstate 15, Lake Elsinore, California				
Job Number:	16164-3	Boring No.:	B-6	Enclosure:	D-2

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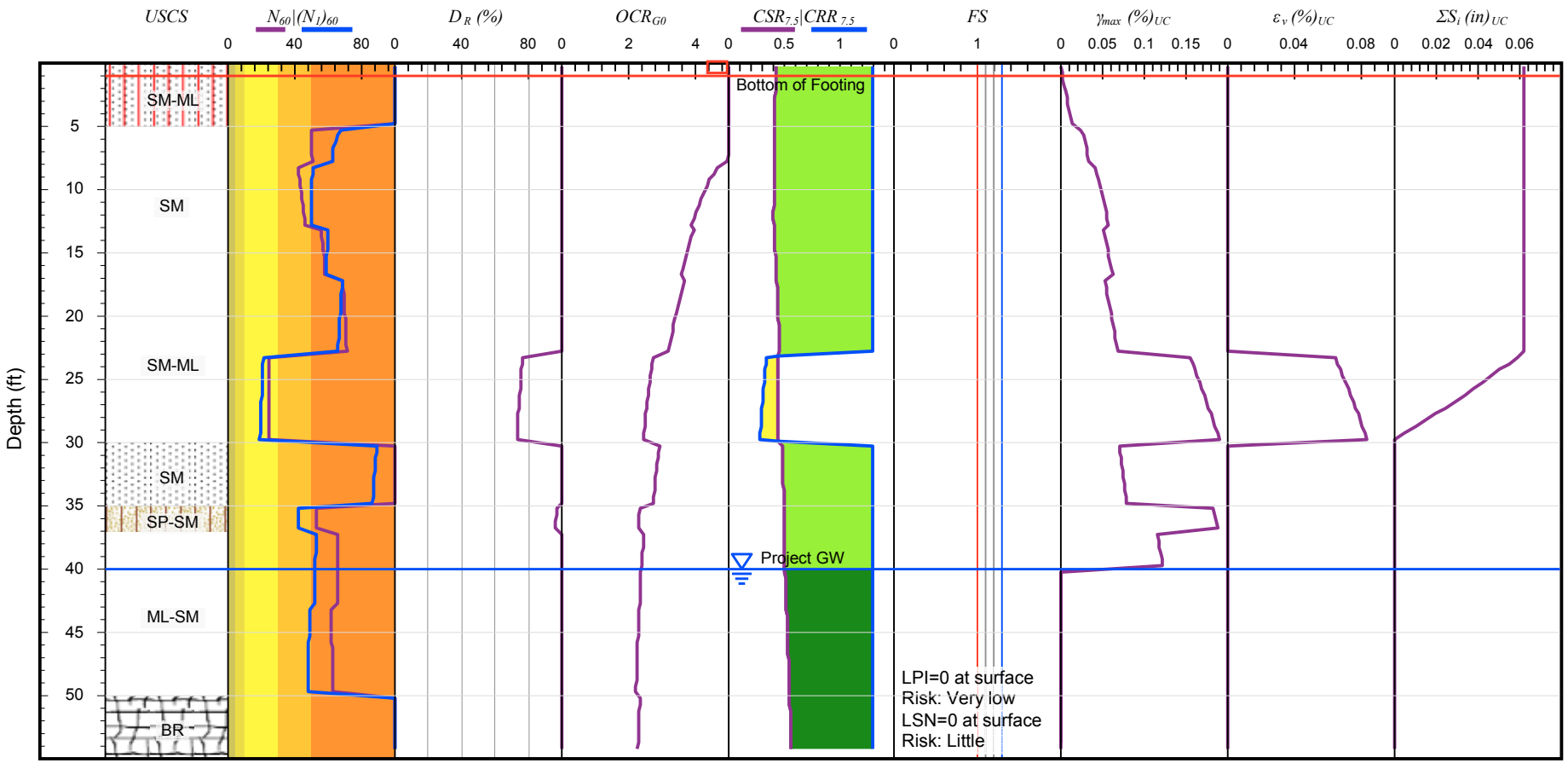

SM-ML SP-SM BR

SM ML-SM

Earthquake & Groundwater Information:
Magnitude = 6.77
Max. Acceleration = 0.865 g
Project GW = 40 ft
Maximum Settlement = 0.06 in
Settlement at Bottom of Footing = 0.06 in

Liquefaction: Idriss & Boulanger (2008)
Settl.: [dry] UCLA (2008-14); [sat] Idriss & Boulanger (2008)
Lateral spreading: Idriss & Boulanger (2008)
M correction: [Sand] Boulanger & Idriss(2004)
σv correction: Idriss & Boulanger (2008)
Stress reduction: Idriss & Boulanger (2008)

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Seismic Settlement Potential - SPT Data

Project:	Proposed South Nichols Grading Project				
Location:	South of Nichols Road, East of Interstate 15, Lake Elsinore, California				
Job Number:	16164-3	Boring No.:	B-8	Enclosure:	D-3

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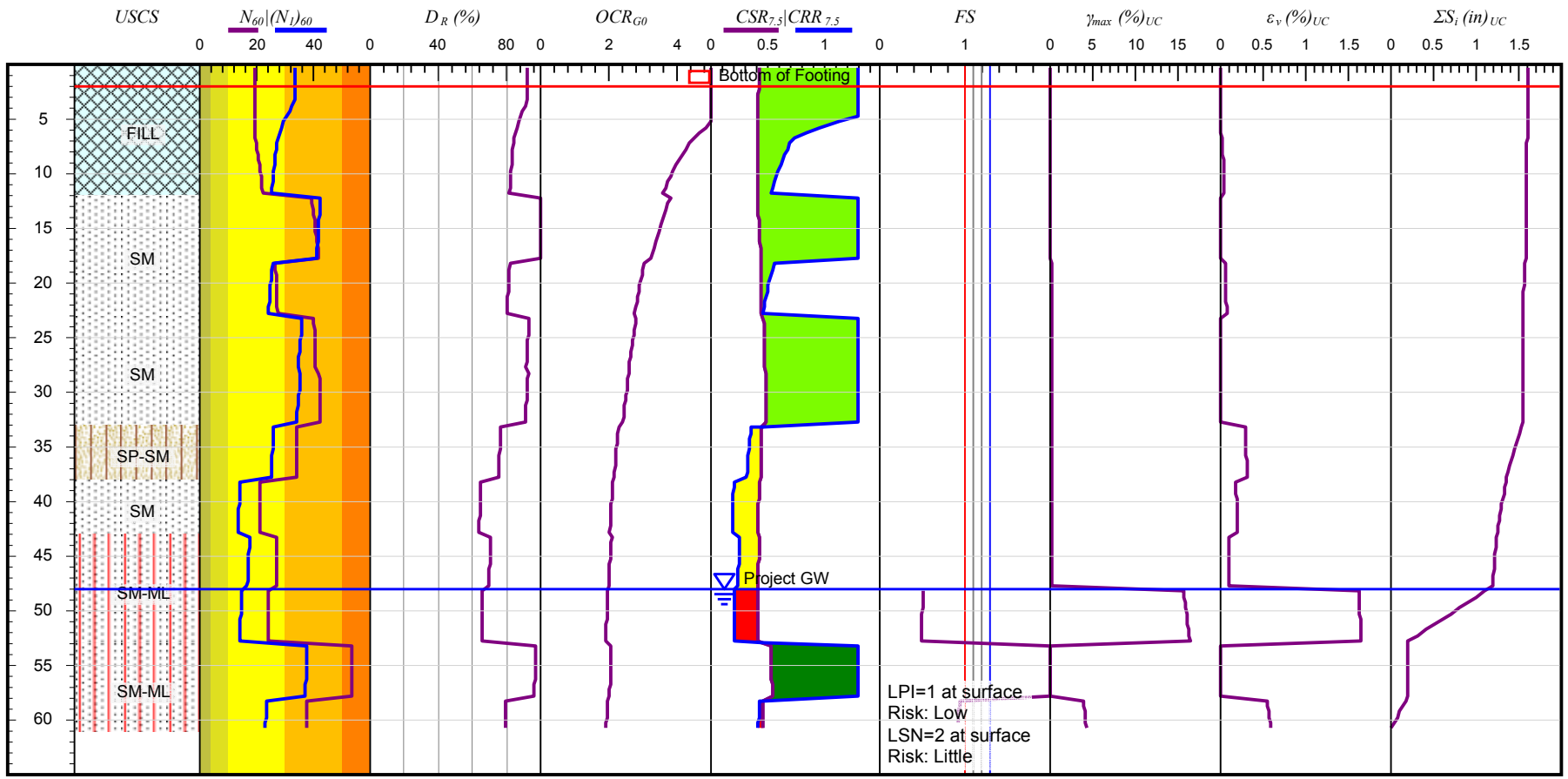

FILL
SP-SM
SM
SM-ML

Earthquake & Groundwater Information:
Magnitude = 6.77
Max. Acceleration = 0.865 g
Project GW = 48 ft
Maximum Settlement = 1.60 in
Settlement at Bottom of Footing = 1.60 in

Liquefaction: Idriss & Boulanger (2008)
Settl.: [dry] UCLA (2008-14); [sat] Idriss & Boulanger (2008)
Lateral spreading: Idriss & Boulanger (2008)
M correction: [Sand] Boulanger & Idriss(2004)
σv correction: Idriss & Boulanger (2008)
Stress reduction: Idriss & Boulanger (2008)

CHJ Consultants

Seismic Settlement Potential - SPT Data

Project:	Proposed South Nichols Grading Project				
Location:	South of Nichols Road, East of Interstate 15, Lake Elsinore, California				
Job Number:	16164-3	Boring No.:	B-3 (Post Grading)	Enclosure:	D-4

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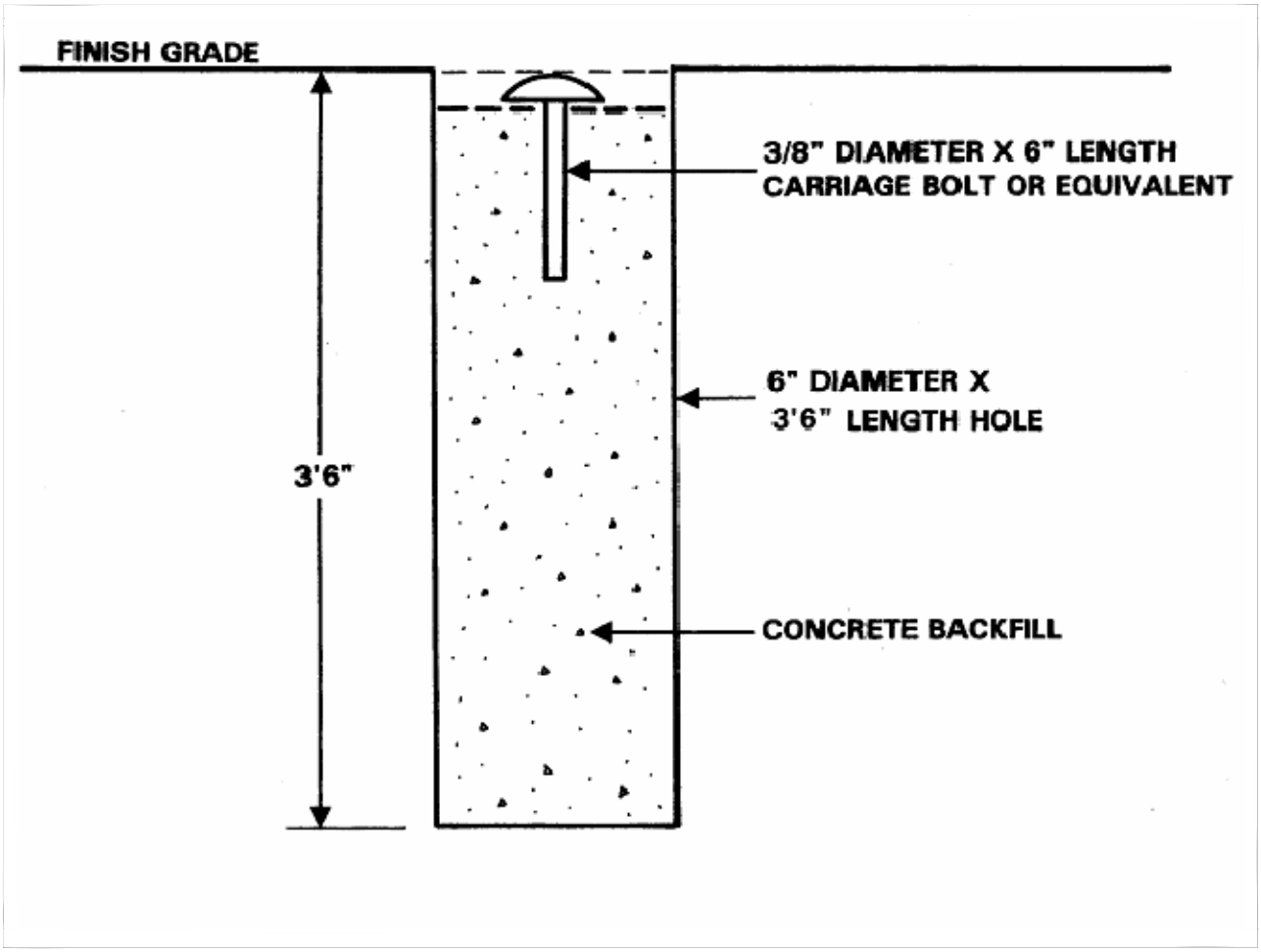
Geotechnical Details

APPENDIX "E"

GEOTECHNICAL DETAILS



SETTLEMENT MONUMENT DETAIL

FOR: NICHOLS ROAD PARTNERS	GEOTECHNICAL INVESTIGATION PROPOSED SOUTH NICHOLS GRADING PROJECT SOUTH OF NICHOLS ROAD, EAST OF INTERSTATE 15 LAKE ELSINORE, CALIFORNIA	ENCLOSURE "E-1"
DATE: MAY 2016		JOB NUMBER 16164-3

CHJ Consultants

SUPPORTING INFORMATION

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Geotechnical, Infiltration and CEQA Services, Tentative Tract No. 37305, Lake Elsinore, CA ■ , 1/23/2018 ■ Terracon Project No. CB175281

Terracon GeoReport

SAMPLING

- Auger Cuttings
- Modified California Ring Sampler
- Standard Penetration Test

WATER LEVEL

- **Water Initially Encountered**
- **Water Level After a Specified Period of Time**
- **Water Level After a Specified Period of Time**

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

N	**Standard Penetration Test Resistance (Blows/Ft.)**
(HP)	**Hand Penetrometer**
(T)	**Torvane**
(DCP)	**Dynamic Cone Penetrometer**
UC	**Unconfined Compressive Strength**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance				BEDROCK		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**
Very Loose	0 - 3	0 - 6	Very Soft	less than 0.25		< 3	< 30	< 20	Weathered
Loose	4 - 9	7 - 18	Soft	0.25 to 0.50	2 - 4	3 - 4	30 - 49	20 - 29	Firm
Medium Dense	10 - 29	19 - 58	Medium Stiff	0.50 to 1.00		5 - 9	50 - 89	30 - 49	Medium Hard
Dense	30 - 50	59 - 98	Stiff	1.00 to 2.00	8 - 15	10 - 18	90 - 119	50 - 79	Hard
Very Dense	> 50	≥ 99	Very Stiff	2.00 to 4.00	15 - 30	19 - 42	> 119	>79	Very Hard
			Hard	> 4.00	> 30	> 42			

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	**Descriptive Term(s) of other constituents**	**Percent of Dry Weight**
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12

GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	**Particle Size**	**Term**	**Plasticity Index**
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

UNIFIED SOIL CLASSIFICATION SYSTEM

Tentative Tract No. 37305 ■ Lake Elsinore, California

February 2, 2018 ■ Terracon Project No. CB175281

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E]		GW	Well-graded gravel [F]
			Cu < 4 and/or 1 > Cc > 3 [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E]		SW	Well-graded sand [I]
			Cu < 6 and/or 1 > Cc > 3 [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay [K, L, M, N] / Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay [K, L, M, P] / Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.